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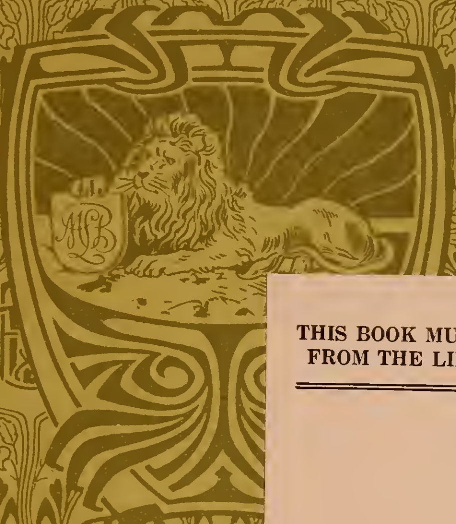

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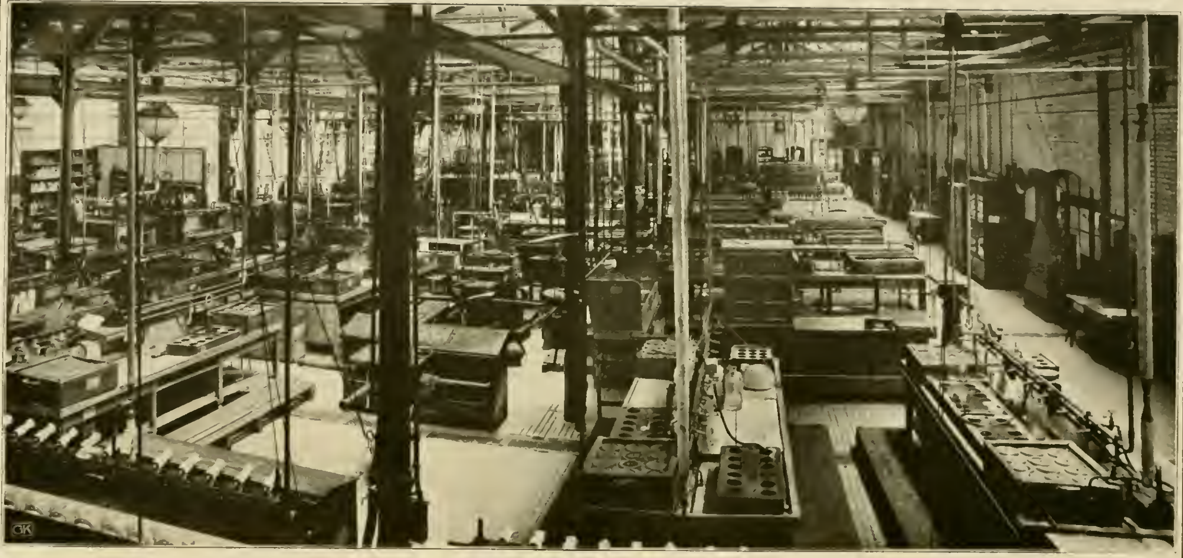

Dyehouse: Interior.

THE COAL TAR COLOURS

OF

FARBWERKE

VORM.

MEISTER LUCIUS & BRÜNING

HOECHST ON MAIN

GERMANY

AND THEIR

APPLICATION IN WOOL DYEING.

SECOND VOLUME.

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Part III.

The practical application of the dyestuffs used in wool dyeing, arranged according to the various branches of the industry.

Of the various animal fibres which the dyer is called upon to bring to greater perfection, sheep's wool plays by far the greatest part. A less extensive use is made of the fleeces of other animals, the most important of which are mohair, obtained from the Angora goat; alpaca, a similar material; cashmere wool, derived from a species of goat living in central Asia; furthermore the hair of the camel, the llama and vicuna, the cow and calf, as well as horse hair, which are occasionally used for certain goods, and lastly the hair of hares and rabbits which is largely employed in the manufacture of hats.

Although the chemical character of the various kinds of wool and hair is pretty much alike, there are nevertheless slight differences in their behaviour in dyeing, so that the affinity of the dyestuffs for the various fibres differs more or less. As a general rule, the finer the fibre of wool or hair, the more dyestuff will it absorb in producing a given shade, since, under equal conditions, the finer fibre, presenting a larger surface in proportion to the bulk takes up more dyestuff than a coarser fibre. Hence it follows that it is advisable to use only a material of as uniform a fibre as possible for goods which are to receive a smooth feltlike appearance through milling, and are to be dyed in the piece; and also that difficulties will easily arise by employing simultaneously wools from different kinds of animals, unless it be intended to produce a contrast between the various fibres.

Generally speaking, the process of dyeing sheep's wool applies to other animal fibres, apart from slight variations which their structure necessitates for obtaining greater or smaller affinity for the dyestuffs. It is therefore not necessary to discuss especially the mode of dyeing of these special fibres, since their treatment can easily be gathered from what is said about wool dyeing. We shall refer later on in detail to the dyeing of the hair of hares and rabbits as carried out most extensively in the manufacture of hair hats, and also to the dyeing of materials consisting of wool and silk.

On the other hand goods made of wool and cotton and containing a larger proportion of the latter for cheapening purposes, must be treated separately. Since, in such cases, not only the cotton is to be dyed, but to appear similar to wool, special methods must be adopted for dyeing, and the selection of suitable dyestuffs, the initial and aftertreatment of the goods, differ vastly from the rules of wool dyeing.

The dyeing of loose cotton which is afterwards worked into dyed wool, will be briefly discussed as an appendix to the chapter dealing with the dyeing of loose wool.

It cannot be denied that of all fibrous substances adopted by the human race for clothing, decoration of dwellings and for other purposes, none has met with so universal and manifold an employment as sheep's wool. Naturally, the claims made upon this product vary with the great many uses to which the material manufactured from it is put. Whereas the dyeing of military cloths is expected to be proof against wind and weather, the chief demand in materials for ball dresses is beauty of shade; the yarn to be used for stockings must keep its colour in the laundry washing, whilst the material for window curtains must, above all, withstand the influence of sunlight.

It has been, at all times, the endeavour of the Coal Tar industry to meet all the various claims made in practice upon the properties of the dyestuffs, and it may here be affirmed, that with the great number of dyestuffs placed upon the market by the colour works at Hoechst all possible and widely varying demands can be satisfied. However, for that very reason the selection of a suitable dyestuff for a particular purpose often becomes very difficult, and it is the object of the following chapters to describe the various branches of the industry and their requirements, and then to discuss the dyestuffs best adapted for each. A brief mention will also be made of the mechanical appliances now at the disposal of the dyer; furthermore, the preliminary and finishing processes of woollen goods will be dealt with, confining this chapter to that amount of detail which appears desirable in order to enable the dyer to recognise their effect upon the colours, and to guard against possible damage and loss.

Corresponding to the many uses ot woollen goods their mode ot production varies, and consequently the dyeing operation is carried out at various stages of the manufacture. Considering that the succession of the latter has a certain connection with the ultimate effects, styles and the demands upon fastness, we shall deal with the separate branches of the industry in accordance with the successive stages of manufacture in which woollen goods are dyed, viz:

1. The dyeing of loose material.
2. The dyeing of slubbing.
3. The dyeing of yarns.
4. The dyeing of piece goods.

I. The Dyeing of Loose Material.

1. The Dyeing of loose wool.

Wool scouring.

Loose wool, as it comes from the sheep's back, is not in a fit condition for manufacturing. It contains from 20—70% of pure wool and, according to the class of sheep and their mode of living, a larger or smaller amount of mechanical impurities (sand and other earthy substances, remains of excrement, and many kinds of vegetable matter), and finally a considerable quantity of so-called wool grease.

Wool grease is composed of alkaline salts of various organic acids, mostly belonging to the higher fatty acids, and of insoluble fats. Both substances are secretive products of the adipose and sudatory glands of the skin.

The object of wool scouring is to extract the grease, and to remove the dirt adhering to the fibres; by this process the wool becomes more open and is thus more suitable for spinning on the one hand, and for imparting to it the most perfect capacity for the absorption of mordants and dyestuffs on the other hand. Simultaneously with the removal of the grease, that of mineral admixtures and mechanical impurities also takes place. The last trace of these are finally got rid of in willowing, spinning and the other operations.

As scouring is the most important of all preparatory treatments to which the wool is subjected before dyeing, and is the fundamental condition for good results, especially in dyeing, this subject must be treated rather exhaustively.

Some wools are washed or partly cleansed on the living animal, with the object of removing part of the wool grease. Foreign wools are frequently treated in the same manner after shearing, in order to save freight. In large establishments the raw, so-called greasy wool, is often subjected to preparatory treatment by steeping in, and washing with water. The soluble parts dissolved by the water consist mostly of potassium salts; the liquid is gradually evaporated and the grease residue further treated, yielding finally the valuable by-product potash.

Nowadays, preparatory scouring is only very rarely resorted to, because experience has shown, that the previous extraction of the soluble alkaline salts is not always an advantage for the cleaning of the wool. Since they are, in regard to their chemical composition, soaps, their intimate mixture with the grease assists the saponification of the latter when brought into reaction with alkalies. Hence the preparatory scouring is at present generally dispensed with, and the greasy wools are treated direct in diluted alkaline solutions for the purpose of grease extraction, i. e. both the soluble and insoluble elements of the wool-grease are removed in a single operation.

Most frequently soda is employed as alkali, also potash, ammonia, putrid urine and soap lyes are used. Sometimes also certain salts, such as common salt or sal ammoniac, are added to the scouring liquor, together with the alkali, in order to accelerate the scouring process. An addition of oleine to the scouring lye is also frequently made for the purpose of forming, by its reaction upon the alkali, an emulsion with the wool grease, and thereby accelerating the solution.

According to their degree of purity, wools are distinguished as:

1. Greasy wools, i. e. wools shorn without any preparatory cleansing.
2. Fleece-scoured wools, which have thereby already been partially freed from wool grease.
3. Half-scoured wools, i. e. such wools as are already partly scoured by soaking in water, as above described; also colonial wools which have been subjected to preparatory scouring in the country of production.
4. Dead wools (fleece wools) and skin wools, which are obtained in tanneries as a by-product in liming the skins.

For the last named skin wools a preparatory treatment with tepid muriatic acid of $1^1/_2{}^0$ Tw. and subsequent thorough rinsing in water is most desirable, in order to remove the greater part of the lime which is left in these wools. If this preparatory process is omitted, and the skin wools are brought direct into the scouring baths, a great part of the lime is not only left loosely adhering to the wool, but is even precipitated on the wool fibre as carbonate of lime by the soda, and this leads at the later dyeing operation to difficulties especially to uneven and dull shades.

Experience has shown that dirty wools are more easily and quickly scoured after being stored for several months in places protected from dampness. Probably the oxygen in the atmosphere produces a kind of oxidation of the grease during storage, which renders it more easily soluble. Such oxidation may, in damp wools, cause a considerable generation of heat, and even lead to self-combustion.

In case the wool is scoured by one of the so called dry scouring processes, which will be mentioned later on, it is first treated in a shaking machine, in order to remove sandy substances.

As a rule however, the wool is entered direct into the scouring cistern, especially in wet scouring, and only very cheap and dirty wools are previously soaked for several hours in cold water, in order to soften the dirt and earthy impurities.

According to the degrees of purity of the wool, the scouring lyes are made up more or less concentrated. In most cases soda lyes of $1^1/_2{}^0-3^0$ Tw.are used. The temperature should, generally, not exceed 122° F, as at a higher temperature, especially when soda lye is used, the wool turns yellow and becomes brittle. Greasy wools can be scoured at 122—131° F, whereas half-scoured wools must not be treated higher than 104—113° F. The scouring and subsequent rinsing are almost always carried on in specially constructed scouring machines (the so-called Leviathans), which consist of several separate shallow becks in which the wool is continually moved along by mechanical agitators, rakes or forks, in such a way that, in being carried from one cistern into the next, it passes through powerful squeezing rollers. These machines do away with the antiquated manipulation by hand which is much more costly and causes the wool to become entangled and felted, apart from the fact that the greasy colonial wools which are so largely used at present cannot be scoured properly by one manipulation, but require several successive passages and continuous treatment.

Experience shows that wool scoured in a newly prepared soda lye is never quite clean, and only the third or fourth lot that has been treated in the same lye becomes well cleaned. Consequently in small dyeworks where only one scouring machine is at the disposal of the dyer the method of practical working generally is, that in fresh lyes first a few half-scoured lots, and afterwards ordinary greasy wools are scoured; or, that the wool scoured in fresh lye is put back for a repeated scouring. For this reason the scouring lyes are used as long as possible. In larger establishments the favourable effect which previously used scouring lyes have on fresh lots is utilized by placing 3—4 cisterns behind one another, and carrying out the scouring in such a manner that the greasy wools are first entered into the first vat which contains the oldest scouring lye, and from which, after being squeezed out, they pass into the next cisterns containing cleaner scouring liquid and finally they are rinsed in the last compartment. When the lye in the first cistern has become too dirty this compart ment is emptied, the lye from the second vessel pumped into it, and so on from the following into the next previous ones. By adding stronger lye the concentration of the liquid is kept up to 2—3° Tw.

After scouring in the alkaline bath, a thorough rinsing in clean water is necessary in order to remove all the alkali from the wool, and to extract any trace of wool grease still adhering loosely to the wool. The softer the water, the cleaner will be the wool after rinsing, for the lime in hard water combines with the soaplike compounds contained in the wool to form lime soaps which, when precipitated upon the wool fibre, make it sticky, yield a bad handle, and produce unevenness in dyeing, spinning and milling. Where no soft water is procurable, it is advisable to soften and purify it; it the improvements thus brought about will invariably pay for the necessary outlay for the purifying plant.

The results obtained in rinsing are the better, the colder the water is. This is due to the fact, that in cold water lanoline and the lime soap which may be formed harden and become brittle, in which state they detach themselves more easily from the fibre; whereas in warm water they are dissolved, become sticky, and, by enveloping the wool fibre as a thin film, impart a dull appearance to the scoured wool.

Favourable as are the results in scouring greasy wools by means of alkalies, especially of soda, the employment of warm alkaline scouring lyes in unskilled hands is frought with considerable risk to the wool fibre, which is extremely sensitive to alkalies. As it is impossible, considering the varying degree of purity of the wools, to prescribe definite quantities of alkali, the determination of the strength must be left to experience. Even the best and most experienced wool scourer will occasionally meet with wools, which he gauges wrongly as to their degree of purity. Any faults resulting from too low a temperature of the bath, or from using too little alkali, become apparent only in later stages. Likewise, through too high a temperature or too large a quantitiy of alkali, the further treatment of the wool and final results can be impaired: the wool turns yellow, and shows difficulties in spinning; it also loses its capacity for milling, etc. etc.

Many experiments have, therefore, been made with the object of avoiding the scouring with warm alkaline solutions, which prove so dangerous to the wool fibre, and about the middle of last century various proposals were brought forward to replace the above mentioned scouring liquids by organic solvents capable of dissolving the wool grease. Hydrocarbons of low boiling points, such as benzine, ligroine and also such compounds as bisulphide of carbon, and tetrachloride of carbon appeared suitable for that purpose. Whilst the employment of the latter seemed to be out of the question until recently, on account of its high price, the first experiments with the other substances proved abortive owing to their being too inflammable. This inflammability is even enhanced in scouring, for dry wool fibres show certain electrical phenomena which, if oxygen is present, cause discharges and explosion of the gases.

It was only by a method much improved in the last decade, that wool scouring by means of volatile solvents has been permanently introduced into the industry. This method, initiated by Emile Maertens and patented in many countries, was first practically adopted on a large scale in the Arlington Mills, Mass. U. S. A., and is now also followed in many wool scouring establishments on the continent.

The essential feature of this method is to avert the danger of explosion of the gases by preventing their contact with the oxygen of the atmosphere. The wool to be scoured is put in hermetically closed cylinders from which, after they are filled and closed, all the air has been forced by some inactive gas, generally by compressed carbonic acid. By means of the latter, the benzine to be used as solvent is then pressed into, and through the reservoirs, which are arranged one behind another. Here also the treatment follows the principle of the counter-current i. e., each reservoir is treated several times with solutions of ever increasing purity. The purification having been accomplished, the remaining traces of benzine liquid, or gas, are removed by a warm stream of carbonic acid before the reservoirs are opened.

Thus the combustible benzine is throughout the whole process prevented from contact or admixture with air or oxygen. The fatty solutions of benzine are then treated for wool grease which, as degras and lanoline, is a commercial commodity of some import. The wool, when freed from grease, is soaked in water and washed without any additon, in order to remove the soluble substances.

It is obvious that the above-described method necessitates an extensive plant. and can therefore only be carried out to advantage on a large scale. The greatly increased cost of production, compared to the wet scouring process, will be compensated by better quality of the wool, greater pliability in spinning, and a better yield of by-products.

The chief disadvantage of the method was, until recently, that, in order to carry out the scouring process properly, the wool had to be in a perfectly dry state, a condition which it was most difficult and costly to fulfil; for otherwise, the benzine did not sufficiently penetrate the wool, and the scouring was incomplete. Moreover, the solutions of grease were opaque, and their further treatment difficult.

This defect is said to have been overcome by another (likewise patented) process of the same inventor. Its essental feature consists in treating the greasy wool, before scouring, with unsaturated aqueous solutions of salts or acids. The fatty solutions of benzine thereby remain clear; moreover, it is possible to remove, in one operation, the potassium salts present in the wool by a treatment with soap solutions.

In another patented process, the inflammable hydrocarbons are replaced by the non-explosive and non-inflammable tetrachloride of carbon. If it is possible to produce this chemical solvent cheaply enough for general application, this process will undoubtedly be taken up very extensively.

In conclusion, we may mention another recent original process, which has been introduced into practice. It is a patented process, in which the greasy wool is passed through a "devil" whilst being treated with a current of air charged with most finely distributed solid substances capable of absorbing grease, such as gravel earth, caoline etc. Their minute distribution produces a very even removal of the grease, after which the soluble potash soaps are washed out.

Doubtless, the newer processes possess advantages over the scouring of wool with aqueous solutions at an increased temperature which favour their adoption, and are likely to still further promote their introduction, provided the cost of installation and working can be reduced.

At all events, it is imperative to give every possible attention to the scouring of wool, as the first and most important preparatory operation. Good scouring is of the greatest importance, not only for dyeing, but also for spinning and weaving. A well-scoured wool should be open and lofty, and not of a yellow colour; it should also be free from sticky matter and felted fibres. Badly scoured wools not only yield bad results in spinning. and produce goods with a disagreeable sticky handle (which defect is even intensified through the subsequent finishing operations), but also occasion unpleasantness in dyeing and milling, because the still adhering wool grease prevents a good penetration and fixation of the mordants and dyestuffs. This disadvantage often shows itself in a greater consumption of mordants and dyestuff than is actually required, and furthermore, in milling, dark shades often bleed into accompanying lighter ones. As the colours are only superficially fixed on badly scoured wool they are easily removed and yield thoroughly uneven effects, especially in piece dyed goods.

The dyer is not infrequently held responsible for such faults and the damage arising therefrom, whereas their origin lies simply in the bad scouring of the wool, which is mostly outside his control.

Sometimes half-scoured wools are dyed for cheap goods, especially for blacks. For other colours, however, the employment of these wools is only permissible in very rare cases.

Carbonizing.

The next preparatory operation to which loose wool is frequently subjected after scouring, is that of carbonization.

The object of carbonizing is to destroy and remove the impurities of an organic nature adhering to the wool, such as burs, straw, and other vegetable remains which have lodged themselves in the fleeces of sheep; also fibres of jute and hemp, detached from the sacks in which the wool has been packed.

All such vegetable impurities are impediments in the further manipulation of the wool, notably in spinning and dyeing. In spinning they show themselves in the breakage of threads; in dyeing in an insufficient absorption of the dyestuffs, so that the goods, when finished, have an unsound appearance. For that reason their removal becomes necessary; it is accomplished by carbonizing, which is carried out in 2 ways: either the woven goods, before or after dyeing, are treated for the removal of vegetable impurities, or, as is largely done, the wool is carbonized in its loose state.

The carbonizing process is based on the fact that vegetable matter is tendered or destroyed by acids or acid salts at a high temperature, due to the withdrawal of water; under the same circumstances the wool fibre undergoes no perceptible change.

As a carbonizing agent sulphuric acid is mostly used. For that purpose the wool is immersed for $^1/_4$—$^1/_2$ hour in sulphuric acid of 4—6° Tw., then hydroextracted and dried in specially constructed ovens, the carbonizing stoves, in which it is left for 1—2 hours at 158—212° F., according to the concentration of the acid, and the construction of the stoves. Through the evaporation of the water, the acid becomes more and more concentrated, and thus destroys the vegetable fibres. The wool is then shaken, and thus the loose carbonized vegetable substances, also mineral admixtures pulverized and removed; finally, it is thoroughly rinsed in order to remove the sulphuric acid still present in the goods. Generally, rinsing in water suffices, but if the acids are too firmly fixed, the goods have be neutralized by a cold soda bath of $1^1/_2$—3° Tw.

Instead of sulphuric acid, hydrochloric acid may be used, and also salts that split off acids at a high temperature, e. g. chloride of aluminium or chloride of magnesium, and bisulphate of soda (tartar substitute).

Hydrochloric acid, which has a milder reaction than sulphuric acid, is principally used for carbonizing shoddy; it is mostly applied in the form of hydrochloric acid gas, which is passed into specially constructed drums containing the rags.

Aluminium chloride and magnesium chloride have also a milder reaction than sulphuric acid, and in order to produce the same effects must be used at a higher concentration (12—18° Tw), and at a higher temperature. For the former the temperature is raised to 212—230° F., for the latter to 239° F. As these two substances affect the dyestuffs less strongly than sulphuric acid, they are preferred, — especially aluminium chloride, — for carbonizing dyed piece goods and multicoloured mixture wools, whilst they are rarely employed for loose white wool.

For the latter, sodium bisulphate is largely used; this has the advantage over sulphuric acid that it is safer and cheaper, although its reaction is less energetic. The carbonizing liquid must be kept up to 11—12° Tw., and in order to effect a thorough penetration of the vegetable matter, it is advisable to leave the material rather longer, — $^3/_4$ hr. — in the bath, before hydroextracting it and taking it into the carbonizing stove. The temperature in the latter must be kept at about 212° F., but may be lowered, if the time for carbonizing is prolonged. In rinsing and neutralizing, wool carbonized with tartar substitute requires less soda than wool carbonized with sulphuric acid; in most cases, rinsing with water alone is sufficient.

At all events, the whole operation has to be most carefully conducted by regulating the concentration of the acid baths, the duration of the carbonization, and the temperature, in such a manner that the carbonized vegetable substances are easily and surely removed, when shaken. Too strong a carbonization, whether produced by too high a temperature or by too strong acid baths, has an injurious effect upon the wool fibre, and renders it brittle. Moreover, it often causes uneven shades by leaving the tips of wool lighter.

It is important for a good result of the carbonizing process that only thoroughly scoured and well rinsed wool be employed for carbonizing. If the wool still contains remnants of soaps or lime soaps, the sulphuric acid liberates fatty acids during the carbonization which, owing to the high temperature, adhere firmly as sticky grease to the wool, and lead to many defects in the subsequent dyeing, spinning and milling operations. More unpleasant still are the consequences of the presence of greasy and soapy substances in badly scoured wools, if magnesium chloride or aluminium chloride have been used. By their reaction the magnesium and aluminium salts of the fatty acids are then formed, which are decomposed by carbonization and "burnt into" the wool, from which they cannot be removed again. They are apt to produce flecks, a greasy handle, and the goods when worn, often show a white nap, especially observable in face cloths, through the reflex of light.

Another point of importance is, that the wool be well and evenly immersed in the acid, also, that it is equally and evenly hydroextracted, and finally brought into the carbonizing stove as quickly as possible. On no account must the liquid be allowed to dry partially on the wool, or the soaked goods be exposed to direct sunlight, for in the dried places, or those exposed to the sun, a stronger reaction of the sulphuric acid takes place, which later on becomes apparent in dyeing, in the form of spots and streaks.

The Mechanical Appliances.

As may be expected, the appliances necessary for dyeing loose wool are of the simplest kind.

For dyeing loose wool it is sufficient to have a vessel, which can be heated. Vats, preferably of a round shape, arranged over an open fire, will best answer that purpose. Such vats are still employed, not only in countries or districts where dyeing is carried out at home, but also in manufacturing centres.

These dye vessels are generally made of copper, for copper resists the various acids used in dyeing, and affects the dyestuffs least injuriously.

In some cases, of course, copper also exercises an injurious effect upon the dyestuff, but this can be easily rectified by avoiding bright metal, and covering the inner surface of the vessel with a protecting layer of oxide.

Much used are also iron vessels which, though cheaper than those of copper, have this disadvantage, that iron is harmful to many colours, and presents the danger of rust stains, especially in light shades.

The heating of the dye vats by direct fire is, of course, the simplest way; however, — apart from the irrational utilization of the heat, and the difficulty of regulating the temperature, and increased cost of working, — is has this drawback, that the bottom of the vessel is generally unevenly heated. The consequence is that when the manipulation is relaxed at any time, uneven shades are liable to result.

The cheapest mode of working is with direct steam, introduced into the vat through an open tube. This however, has also great risk, apart from the fact that the steam condenses in the bath and increases the volume of liquid. The wool is apt to become felted, it takes up the dyestuffs more irregularly, and the latter are moreover not so well fixed, since the temperature cannot be raised as high by open steam as by closed steam coils.

For the above reasons dye vats heated by indirect steam are coming more and more into use.

These vessels, placed upon an iron frame if of small size, or let into brickwork if of larger dimensions, have on the lower side a plug, and a double bottom. The steam enters into the upper part of this space and passing through coils leaves it, together with the condensed water, at the lower part. These vessels are generally made of copper throughout. Tin-lined copper, or tin, are less to be recommended, as tin is liable to affect the Azo dyestuffs. The heating of these vessels can be easily regulated.

If the construction of the vessel is correct, a uniform flow of the liquid from below, upwards along its sides, thence into the interior and downwards takes place, so that a good and even dyeing is ensured, with relatively little manipulation.

A still better circulation of the liquid is obtained by a combined system of direct and indirect heat. For this purpose jacketed (double) pans are used, which contain at the bottom a direct perforated steam pipe covered in by a sieve. Such vats boil very evenly, so that they mostly render the stirring (poling) superfluous, when once the liquid has been brought to the boil.

The same advantage is not shared by the square wooden cisterns, in which the material must be more vigorously and continuously worked, whereby it becomes more felted.

Better are those wooden cisterns which, although square at the top, have a cylindrical bottom, for they allow the wool to be much more conveniently manipulated with the hooks and poles.

In order to effect an even mordanting and dyeing, the wool must be well poled, both before and after the additions of mordants and dyestuffs; on the other hand, the manipulations must be carried out with great care so as to avoid felting. For the same reason, the turning by means of forks must not be done quickly and sharply, but slowly and evenly.

Owing to its manipulation and the circulation of the liquid, it is often impossible to prevent the wool from becoming entangled and felted; especially fine qualities have a tendency thereto. It is, therefore, quite natural that for the dyeing of loose wool, mechanical contrivances have been devised, the essential feature of which is that the material is placed in a fixed stationary position and the liquid circulated through it; the poling and the use of forks is avoided, whereby much less entangled and felted goods are obtained. The mechanical dyeing contrivances have been adopted for dyeing loose wool all the more readily, as with the latter it is easy to effect in the apparatus an even packing of the material, offering in all parts an equal resistance to the circulating dye liquid.

It would carry us too far here, to enumerate the many dyeing machines that have been constructed and are employed for dyeing loose wool. Such a list would exceed the scope of the present work; and, on the other hand, the critical sifting of the material at hand for a discussion of apparatus dyeing is too difficult, inasmuch as each of the many constructions in use has certain advantages of its own; and, lastly, the selection of the one or the other dyeing apparatus depends greatly upon the conditions of labour, the water supply, and the quality of the material to be dyed.

It is, therefore, our purpose only to touch upon the mechanical dyeing apparatus in general outline, referring for more detailed information to the work: "Die Apparatefärberei' (Apparatus Dyeing) by Dr. Ullmann, published by Julius Springer, Berlin.

The simplest construction of mechanical dyeing apparatus, all based on the aforementioned principle that the material to be dyed remains at rest while the dyeing liquid circulates through it, is that of those apparatus which consist of a simple dyeing vessel with a double bottom, under which a collecting space for the liquid oozing through the material by its own weight is formed. From this collecting space the liquid is continually drained by means of a pipe fitted with a rotary pump, or by an injector, which may at the same time serve for heating the liquid. The latter then runs back into the vessel through a pipe prolonged so as to extend over its edge, and which may be fixed either outside or inside, in order to resume once more the penetration of the goods, by repeating the above-described circle.

In other constructions a sieve cover is placed on the top of the material, and the liquid, instead of penetrating the goods by its own weight and being pumped back again, is inversely pressed through the goods and runs towards the pump through an overflow pipe. This construction has the advantage over the former, that the upwards rising liquid and downwards acting weight of the wool are, as it were, working in conjunction with each other, whereby a too firm compression of the goods and the formation of rills of the liquid are obviated.

Other machines, with a view to avoiding these evils, have, instead of one double sieve bottom which only encloses one layer of wool, been fitted with several of them, so that several layers of material can be got at the same time.

Those machines which contain two cisterns instead of one, these being connected with one another by an overflow and a system of pipes, which are in their turn connected with the pump, so that the liquid is simultaneously sucked out of one vessel and forced through the second one, whence it runs back intot he first vat through the overflow pipe, must be regarded as a further improvement. By reversing the pump either by hand or some mechanical contrivance, the course of the liquid may be changed at will. This interchangeable circulation obviates compression of the material and the formation of rills.

Other machines are constructed in such manner that the liquid does not pass through the goods in a vertical but a horizontal direction. To that end the receptacle for the goods has a cylindrical shape, with perforated sides, whilst the top and bottom are closed. The inner cylinder, likewise closed on the top, ends at the bottom in a pipe which is connected with a pump. By setting the latter into motion, the liquid is forced into the inner cylinder, passes through the perforated sides through the material, thence again through the also perforated outer side of the receptacle into the surrounding space where the liquid is collected, in order to pass again into the pump.

More effective, however, is the reverse direction of the circulation of the liquid from outside inwards. This largely used construction ensures a more even dyeing of the materia nasmuch as here the outer relatively larger layers of the goods are brought into contact with the more concentrated dye liquid, whereas the inner layers of the wool, being smaller in compass than the outer ones, are passed through by the now more diluted, but proportionately larger amount of liquid.

Finally, there are in use, machines of similar construction to those above-described which allow the liquid to flow alternately from the outside to the inside and reversed as desired. The machines are naturally completely closed up every-where (inner reservoir, cylinder and the outer reservoir), in order to change the circulation at will. These machines possess this advantage over the afore-named, that the liquid penetrates the material in alternate directions, which tends to enhance evenness in dyeing, whilst in the other machines the liquid is only worked in one direction. The one obvious disadvantage of these machines however is, that owing to the perfectly closed receptacle the taking of samples and the observation of the liquid are impossible.

In conclusion we may mention a mechanical dyeing apparatus which, strictly speaking, does not belong to the class discussed. The former, especially those constructed in Germany, aim at preserving the material by keeping it in an immovable positon whilst the liquid is circulated through it; the object of the machines comprised under the name of the Klauder-Weldon apparatus, however -- which have been adopted in England and particularly in America, — is to replace manual by the cheaper mechanical labour.

These machines consist of a large vessel which serves for holding the mordanting or dye liquor. Within the same, reaching down to half or two thirds of its depth, revolves a cylindrical receptacle, divided into 4 compartments, into which the wool is evenly packed. The whole apparatus is covered in, in order to prevent as much as possible the cooling of the liquid. In consequence of the revolving of a large wheel, the wool in the receptacles passes with regularity through the dyebath which, by that means, penetrates the goods evenly.

The mechanical contrivances for dyeing loose wool with indigo will more conveniently be mentioned in discussing this branch of dyeing (page 19), as they are only used for that purpose.

Although it is advantageous in all branches of dyeing to use soluble dyestuffs and mordants, it is absolutely imperative to select easily soluble ingredients when using a mechanical dyeing apparatus. This is due to the fact that the material through which the dye liquid has to pass, acts as a filter upon all undissolved portions of dyestuff.

It is, therefore, necessary that the dyestuffs, mordants, and auxiliary ingredients employed should be easily soluble, or at least, if they are not so from the beginning, should dissolve surely and completely at boiling heat, nor should they produce any deposit in the bath, either alone or by reacting upon one another. Unless these conditions are complied with, the dyestuff is unsuitable for apparatus dyeing, for its employment would be attended with many difficulties and disadvantages.

If the dyestuff does not at once sufficiently dissolve, the undissolved portions adhere and fix themselves to those layers of wool which come first into contact with the circulating liquid, and choke up the interstices between the separate fibres, so that the pump can no longer sustain a sufficient circulation. Should such deposited dyestuff soon dissolve at the raising of the temperature, it is still possible to avoid ill effects; but if this is not the case, uneven and insufficiently dyed lots will result, which are liable to rub off in parts or to bleed in consequence of the superfluity of dyestuff contained. The same defects present themselves if the dyestuff though dissolving easily at first, is precipitated either by the addition of acid, which may appear necessary for exhausting the dyebath, or by the too early addition (i. e., before the liquid is sufficiently exhausted) of metal salts intended for its development

It is, therefore, necessary in dyeing on mechanical apparatus to be careful in the choice of dyestuffs, for though they may meet all demands as to fastness, they might not be suitable for a mechanical appliance. Considering the great variety of apparatus in use, it is, as a rule, only possible to decide by a practical test, whether or not a dyestuff is suitable for a certain apparatus.

The Dyeing of Loose Wool for plain shades.

Plain, heavy, face-cloths, army cloths, carriage cloths, and fine overcoatings are mostly dyed in the wool, partly because these goods are so closely woven and are so heavily milled, that dyeing in the piece would not bring about thorough penetration; partly also, because it has become so customary to dye finer qualities in the wool, that in German, the expression "dyed in the wool" is practically synonymous with "fast and faultless".

The conservative mind of the public, which associates fastness with goods which were dyed in the wool, demands as proof certain decorative white or coloured selvedges and show-ends, and this therefore is still very often the reason why plain shades are mostly dyed in the wool. Yet it is possible nowadays, to dye the identical shades equally well and fast in the piece, apart from the fact that undyed wool is spun more easily and handled to better advantage than dyed material. Of course, it cannot be denied that the troublesome and more expensive method of carrying out the various processes of manufacture with dyed material is essential for certain heavy goods which have to undergo a severe milling. Moreover the dyeing of loose wool offers, after all, certain advantages to the manufacturer: he is able to keep up required dimensions, and is sure of delivering large orders uniformly.

The fine quality of the above-mentioned goods naturally makes great demands upon the fastness, especially to light and wear, of the dyestuffs. Moreover, since the colours have to stand heavy milling, only the very fastest can be considered: Indigo, Alizarines, and the developing colours, especially the Acid Alizarine Colours which equal the latter in fastness. As no secondary colours or white are to be taken into account, even those dyestuffs are still suitable for plain shades, which bleed slightly in milling, or rub; of course these colours must not change their shade nor suffer any perceptible loss of depth in milling, nor must they rub when the goods are finished.

However, all colours must be perfectly fast to ironing and stand severe steaming, in many cases wet steaming; they are also often expected to stand carbonising in the piece.

The number of shades to be considered for dyeing loose wool for one-coloured-effects is relatively limited, and consequently also the number of dyestuffs used for their production. The principal colour for face cloths and overcoatings is black; then follow blue, and brown, while the other shades — green, red and drab, — which are used for fine carriage cloths etc, form only a small part of the total production.

In the following pages the principal colours and the dyestuffs and combinations of dyestuffs, employed in their production will be discussed.

Black.

Black shades upon loose wool are best produced with our Acid Alizarine Black SE, SET, SN, and SNT, of which the two former are put upon the market both in paste and powder form. These dyestuffs meet in the highest degree all demands which can be made upon a fast dyestuff.

The above-mentioned brands of Acid Alizarine Black belong to the chrome developing dyestuffs, and are dyed in one bath. They have, consequently, this advantage over the old Logwood Black, which is still so largely used on account of its cheapness, that the so dyed wools remain more pliable for spinning, and are incomparably faster to light. Also, as regards their behaviour in heavy milling, steaming, and carbonising, these Acid Alizarine Blacks satisfy all possible demands, so that they have been approved of in Germany and various other countries for the dyeing of army cloths.

1% oxalate of ammonia
17,5% **Acid Alizarine Black SE paste**
3% acetic acid; 3% acetic acid

2,5% bichrome.

As regards the properties of these dyestuffs, when compared with each other, Acid Alizarine Black SE and SN produce a beautiful blueblack shade, similar to that of logwood; whereas SET and SNT yield a fuller and deeper black. On the other hand, the SN and SNT brands are distinguished for being more easily soluble, and therefore better suitable for dyeing in a mechanical apparatus than the SE brands. They are also faster to rubbing, and sulphuric acid may be used in dyeing, whereas, Acid Alizarine Black SE and SET are advantageously dyed with acetic acid, and sulphuric acid only used to exhaust the baths, especially for coarser wools.

In using the latter two brands it is very necessary to employ soft water; hard water must therefore be previously corrected by the addition of oxalate of ammonia.

1% oxalate of ammonia
18% **Acid Alizarine Black SE paste**
0,1% **Patent Blue A**
5% acetic acid; 3% acetic acid
2,5% bichrome.

In order to produce a full blueblack, it is necessary to use, according to the quality of the wool 15—20% Acid-Alizarine Black SE paste, or 3—4% in powder form.

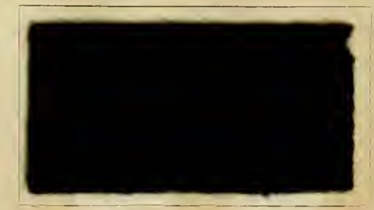
The dyebath is prepared with oxalate of ammonia and well stirred; then the dyestuff, made into a paste, and 5% acetic acid are added. The goods are entered at 158—176° F. and the temperature raised to the boil. If, after boiling for $^3/_4$ hr. the bath is not exhausted, an additon of 2—4% acetic acid or 1—2% sulphuric acid is made,and the whole kept boiling for another half hour. Thereupon the shade is developed by the addition of 2,5 to 3% bichrome and further boiling for $^3/_4$ hr.

When dyeing carbonised wool care must be taken that the material be well neutralized, as otherwise too much acid is present in the bath, which causes the dyestuff to be too quickly deposited upon the fibre, and consequently the colours will not be fast to rubbing. In dyeing these wools no acid must be added at the beginning, but only after about $^1/_2$ hour's boiling, in order to exhaust the dyebath.

The dyeing operation in a mechanical appliance is carried out in a similar manner: the bath is prepared first with the dyestuff and oxalate of ammonia and then the acetic acid is gradually added, most conveniently through a dripping apparatus.

For darkening (saddening) Acid Alizarine Black SE it is advisable to use dyestuffs of equal fastness such as Alizarine Red IWS, Acid Alizarine Red, Acid Alizarine Grenade R, Acid Alizarine Brown, Acid Alizarine Yellow, Mordant Yellow etc.; suitable for shading purposes are, in smaller quantities, Patent Blue A, Fast Acid Violet, Acid Violet and other dyestuffs, which withstand bichrome and are fairly fast to milling.

In a simpler manner deep black shades are obtained by using Acid Alizarine Black SET. For instance, a black such as is required for the melange of the Prussian infantry trousers, is produced in the following way:



1% oxalate of ammonia
16% **Acid Alizarine Black SET** paste
5% acetic acid; 2% sulphuric acid
2,5% bichrome.

The bath is prepared with 1% oxalate of ammonia, 16% Acid Alizarine Black SET paste and 5% acetic acid. The goods are entered at 140—158° F, the temperature is raised to the boil, and boiling continued for $^3/_4$ hr., 2% sulphuric acid are then added, and after further boiling for $^1/_2$ hr. the shade is developed with 2,5% bichrome by boiling for another $^3/_4$ hr.

For shading off or neutralizing Acid Alizarine Black SET the same chrome developing and acid dyestuffs are used as for Acid Alizarine Black SE.

Acid Alizarine Black SN and SNT, show a rather different behaviour from that of the SE brands, (as was already mentioned above). These dyestuffs do not necessitate a correction of the water with oxalate of ammonia; according to the quality of the wool and the depth of the shade required 4–7 % are used for producing a solid black. They are dyed with the addition of 10 % Glauber's salt and 3–5 % acetic acid, or sometimes with 2 % sulphuric acid; the goods are entered at 104—122° F., the bath heated to the boil, and after boiling for $^3/_4$ hr. as much sulphuric acid is added as is necessary to exhaust the bath, which will be from 1–3 %. Then the shade is developed by the addition of 2—3 % bichrome and further boiling for $^3/_4$ hr.

1 % oxalate of ammonia
5 % **Acid Alizarine Black SET** powder
0,25 % **Acid Alizarine Brown BB**
0,2 % **Mordant Yellow O**
5 % acetic acid; 2,5 % acetic acid
2,5 % bichrome.

Bright copper vessels turn the shade slightly reddish; it is therefore advisable not to polish them too much, and to add to each 200 gallons of dye liquid 4 oz of sulphocyanide of ammonia.

Here also the same dyestuffs are used for darkening and shading as are employed for Acid Alizarine Black SE.

A saving of time and expense can be effected in using the old baths of the above mentioned blacks over again. For that purpose it is necessary however to have two baths, one for dyeing, and one for developing.

6,5 % **Acid Alizarine Black SN**
10 % Glauber's salt, 5% acetic acid;
2 % sulphuric acid
2,5 % bichrome

The Acid Alizarine Blacks can also be fixed upon previously mordanted wool. The shades thus produced are exceedingly fast to milling and wear, and on account of yield and cheapness, are often used in this way in combination with Alizarine Blue, Alizarine Red 1WS and other mordant dyestuffs, for the production of darkblue to blueblack shades.

7 % **Acid Alizarine Black SNT**
0,2 % **Mordant Yellow O**
0,2 % **Alizarine Red 1WS powder**
10 % Glauber's salt, 5 % acetic acid;
3 % sulphuric acid
2,5 % bichrome.

When dyeing Acid Alizarine Black SE on previously mordanted wool, the latter is mordanted in the usual way with bichrome and tartar or some other reducing agent, and then dyed in a second bath, which is prepared with 1 % oxalate of ammonia, and 5 % acetic acid. After boiling for about ½ to ¾ hr. the bath is exhausted by the addition of 3—5 % acetic acid; and finally the shade is fixed by a further addition of 0,5 % bichrome and boiling for another ½ hr.

3 % bichrome, 2,5 % tartar
1 % oxalate of ammonia
13 % **Acid Alizarine Black SE paste**
5 % **Alizarine Blue A paste**
0,8 % **Alizarine Red 1SW powder**
5 % acetic acid; 4 % acetic acid
0,5 % bichromate.

In addition to the brands already mentioned the following brands are also suitable for dyeing loose wool for plain goods. viz., Acid Alizarine Black R, RH, T and AC. Although these do not occupy the same rank as the Acid Alizarine SE and SN brands, in respect of fastness to heavy milling and potting, they often satisfy the demands made upon black in one-coloured styles; especially for certain finishes they possess advantages which facilitate their employment: they are very soluble and equalize extremely well, for which reason they are particularly suitable for apparatus dyeing.

The goods are dyed with Acid Alizarine Black R, RH, T and AC, by adding 10% Glauber's salt and 3—4 % sulphuric acid to the dyebath and the shade is developed with 1,5—2,5 % bichrome. In order to counteract the injurious effect of copper, in copper vessels, 4 oz sulphocyanide of ammonia must be added to each 200 gallons of dye liquid. The above-named dyestuffs can likewise be used on a mordant but it is advisable to add finally 0,5—1 % bichrome in order to effect a perfect lake formation.

A black on loose wool, fast to milling, is also produced with Chrome Black, the most important brands of which are B, 2G and T. These dyestuffs are used in conjunction with Glauber's salt and acetic acid, and the shade developed by an aftertreatment at the boil with 1½—2 % bichrome and 3 % sulphate of copper.

6 % **Chrome Black B**
2 % **Chrome Black T**
10 % Glauber's salt, 10 % acetic acid
2 % bichrome, 3 % sulphate of copper.

As regards milling and carbonising these blacks satisfy all demands; they withstand also a not too severe steaming, but are not as fast to light as are the Acid Alizarine Blacks which surpass all other artificial dyestuffs in that respect; on the other hand they excel the ordinary logwood black as regards fastness to light.

Blacks of great beauty and very fast to light can also be produced with Chromotrope S. This is dyed with the addition of Glauber's salt and sulphuric acid, and developed with bichrome, to which are added some lactic and sulphuric acid. The blacks produced with this dyestuff bleed reddish when severely milled, but of course this disadvantage is of no moment in one-coloured styles. But since the dyer rarely knows for what purpose the dyed wool will have to serve eventually he will have to be careful in the use of Chromotrope S for loose wool.

Blue.

For the production of the various shades of blue upon loose wool for plain shades. Indigo is doubtless the most important dyestuff, as its general fastness surpasses that of all other competing artificial dyestuffs; the employment of Indigo, which since its synthetic manufacture does not vary in quality is steadily increasing, for its application is cheapened considerably through improvements in its manipulation. Next to it, but in the second rank only, must be placed the rival products of Indigo, the most important of which is Alizarine Blue, besides which may be mentioned, a number of chrome developing colours: Chromotrope F4B and DW and Fast Mordant Blue B and R, and, lastly, Alizarine Direct Blue B which occupies a place peculiar to itself.

Considering the importance of Indigo and the different modes of application we will describe in the first place the mechanical dyeing apparatus adapted to Indigo dyeing.

As already explained in our general discussion of Indigo dyeing (vol I, 145 and following page) the most ancient application of Indigo is in the fermentation vat, and, as may be expected, the apparatus employed are very simple.

In hot countries the fermentation vat consists to this day of ordinary vessels which are placed upon the floor or fixed into the ground and filled with the required amounts of Indigo and fermentation agents, are left to themselves until the solar heat has brought about the fermentation and effected the reduction of the Indigo. The wool is then entered into the vat and, having remained therein for some time, is lifted out with sticks and left in the open air until the blue is developed by oxidation.

In a similar manner dyeing with Indigo is carried out in the Transylvanian urine vats, into which the unscoured wools are rammed in their greasy state together with potash, urine water and Indigo; these vats are left to themselves for several days until the reduction of the Indigo has taken place through the process ot fermentation.

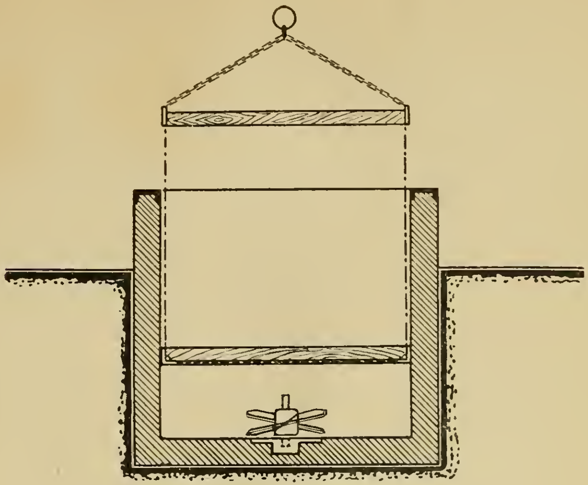
In colder countries where the temperature of the sun or atmosphere no longer suffices to bring about a strong enough fermentation, the same must be assisted by artificial heat. The older and simpler apparatus are constructed of stone and cement, or of iron or copper and heated by direct fire.

The fermentation vats can only be worked slowly and do not permit of more than a few dips per day; this led therefore to the construction of larger vats in order to increase the output, apart from the fact that vats of larger capacity are comparatively less affected by errors in the addition of fermentation agents and lime, and less susceptible to fluctuations of temperature or other exterior influences. In order to facilitate the manipulation of such large vats, which have a capacity of 1200—2000 gallons, and to save space, they are generally sunk into the ground and provided with direct or indirect steam for the better regulation of the temperature.

A net suspended from a crane above the vat, or a frame to which a net or a perforated metal plate is fixed, and which is lowered into the vat, serves for the reception of the wool. After having been left sufficiently long in the liquid the frame is wound up again, allowing the superfluous liquor to run back direct into the vat. The latter is then covered over with boards and on these the net is spread out for the purpose of allowing the wool to oxidize; the upper layers which oxidize very quickly are first taken out of the net, and the other wet layers then squeezed out by hand.

This simple procedure is, as already mentioned, beset with various defects. We therefore give, in the following, the description of an installation of a well and rationally working fermentation vat, as it has been largely adopted in practice.

The vats are placed in a row at one end of the dyeworks; in front of them is a small track of rails on which the squeezing and dyeing apparatus and small waggons with the goods can be run to and fro as required. All the vats are made of the same dimension, so that the auxiliary apparatus can be used for any one of them. The vats are of cubical shape, being each 7'2" broad, long and deep. They are generally built of bricks, cemented inside, but are also often made of wood or metal.

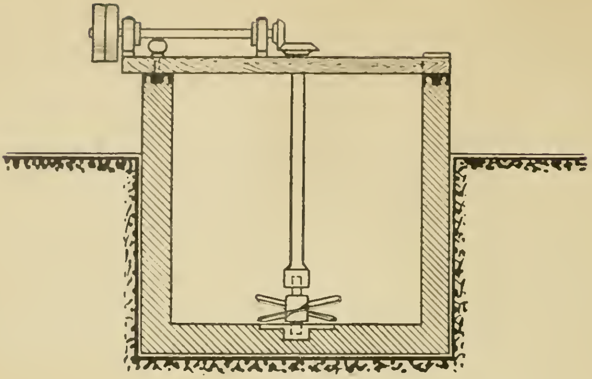


The walls of the vats are perpendicular and sunk into the ground to about $^3/_4$ of their height, so that they stand out about 27 inches above ground. In each vat there is one open and one closed steam coil, so that it is possible to heat the liquid by either direct or indirect steam, according as its level is either too high or too low.

For the sake of protecting the upper rim of the vat against damage, it is provided with a kind of cast iron frame which carries at the same time the necessary provisions for fixing the auxiliary machines.

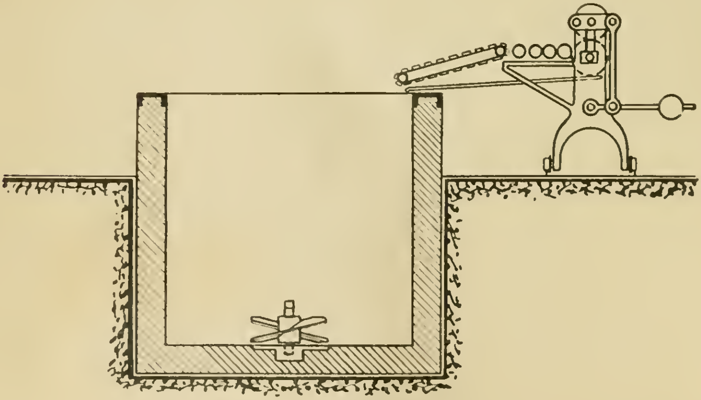
The net which serves to hold the wool during the dyeing operation, is of a square shape and fits exactly into the vat. It is made of wire and is stretched over a frame of wooden laths to which are fixed the ropes by means of which the net can be raised and lowered. On each of the four sides of the frame there are also wooden laths about 4 inches high, fixed with hinges so as to flap down towards the outside; their object is to guide the net in lowering into the vat, and flapping outwards when the net is raised, to trail along the walls of the vat, and thus to prevent the wool from falling back into it. When the net is lifted quite out of the vat, the flaps turn outwards, and thereby cover up the whole width and breadth without however interfering with the taking off of the wool.

In order to stir up the vat liquor, a screwpropeller is used, which rests on a bed at the bottom of the vat, and whose upper end, being square shaped, fits into a corresponding square hole at the lower end oft he drivingshaft. The upper part of the latter runs into a bearer beam which is laid across the vat, and is fixed by means of several pins or screws fitting securely into corresponding holes in the centre of two opposite sides of the vat: The propeller is set into motion by connecting the driving shaft with a cogwheel gear. The shaft and the driving mechanism



can thus be quickly attached to, and, when required, be removed from one vat in order to serve the same purpose on another.

The squeezing apparatus which, as has already been stated (vol I, page 146), can also be employed with advantage when working the fermentation vat, runs on iron wheels, so that it can be moved quickly to each vat according to requirement, and is then connected by adjustable belts with the driving gear.



The two squeezing rollers are made of cast iron and have a diameter of about 12 inches; the lower one rests on a firm bed, while the upper one is movable and is pressed against the other by screw and weight levers. The lower roller is without cover, whilst the upper one is covered all over with woollen cords.

The wool is brought from the vat to the squeezing rollers, which are about 30 inches long, by means an endless band, consisting of a strong belt of hemp with staves of cane sewn on, or of iron rods rivetted on link chains. The endless band reaches in a slightly slanting position from the squeezing rollers backwards over the rim of the vat, and underneath it, also slanting toward the vat, is a board over which the superfluous liquor runs back into the vat.

Having regard to what has already been said in the chapter on vat dyeing (vol. I, 147 and following pages) it is needless again to enter at length into the methods to be followed in dyeing in the fermentation vat, since it is impossible owing to the varying condition of the vat, to determine with the same exactitude as in the case of other dyestuffs, the proportions necessary for producing a certain shade, the duration and number of dips. We therefore merely wish to refer to the preparation of fermentation vats as mentioned in vol I, page 149; we cannot too strongly urge the employment of squeezing rollers in fermentation vats, because by their means colours of greater fastness to rubbing are produced and a saving of Indigo is effected which soon pays for the expense of the squeezing apparatus.

Prussian Infantry Uniform Cloth.

Indigo MLB, dyed on the fermentation vat.

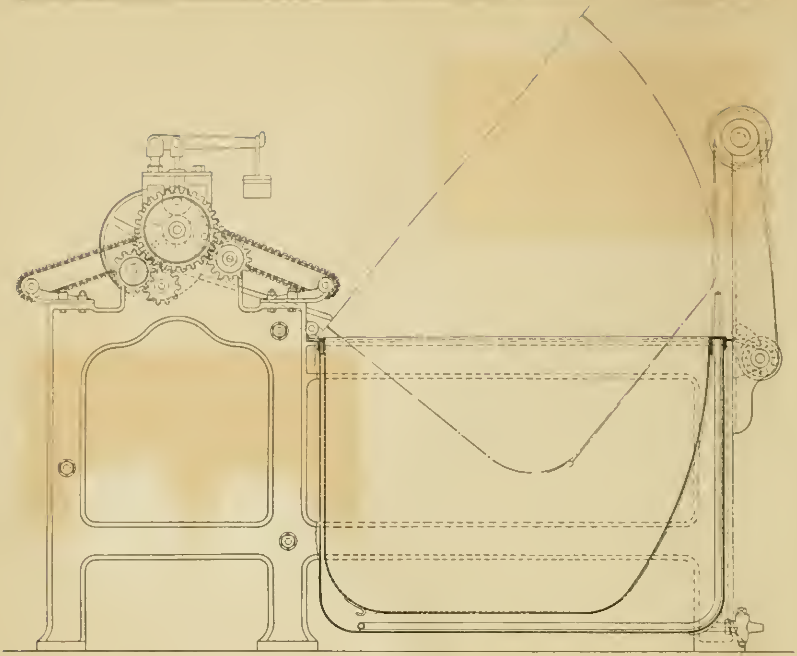
For dyeing in the fermentation vat we recommend in the first place Indigo MLB paste, which should only be replaced by Indigo MLB powder or lumps where difficult conditions of transport or heavy duties render it necessary. The two latter brands, as already stated in vol. I, page 156, must be ground before being used in the fermentation vat.

Very good results are also obtained in the same vat with Indigo MLB, vat I, the use of which, however, requires rather more fermentatives, whereas less alkali is necessary.

Recently Indigo MLB/W has been put on the market; this may be used in fermentation vats with the greatest advantage. The fact that this preparation already contains the Indigo in the form of Indigo White which only needs to be dissolved by the addition of lime, permits of a much better utilization of the fermentation vat, for the fermentation only requires to be kept active for the time sufficient to neutralize the oxygen which is introduced into the vat during the operation. The reduction of the Indigo, — the process occupying the longest time, — can be neglected when using Indigo White MLB/W. For this reason it will no doubt play a great part in fermentation vat dyeing in future.

Of the Hydrosulphite Vats we will only mention the "Hoechst Vat" i. e., the Glue-Hydrosulphite-Ammonia Vat. The mechanical appliances used for this differ considerably from those of the fermentation vats; in the first place, the dimensions of the cisterns are smaller ($^1/_3$ of the former). This is due to the fact that the hydrosulphite vat, which is free from sediment, does not require the dead space necessary for depositing the sediment of the fermentation vats. We illustrate, in the following sketch, the installation of a hydrosulphite vat which has met with considerable favour.

The apparatus consists of an oblong rectangular cistern made of sheet-iron, and containing about 800 gallons; at the lower end is a plug and along its bottom a closed steam coil. Inside the cistern and fitting to its sides, there is a cage made of perforated sheet-iron, which on one of the smaller sides, rests upon hinges so that it can be easily raised and lowered by means of a pulley fixed at the opposite side. Fixed to the first-mentioned smaller side of the cistern is a squeezing apparatus, consisting of a pair of rollers, the lower one of which runs in a fixed bed, whilst the upper one is pressed upon it by means of a spring or, better



still, by a lever. The lower roller is made of cast-iron, the upper one of vulcanite or metal in which case it is covered with hemp or woollen cords.

The wool is transported to the squeezing rollers by means of an endless band slanting towards the vat and reaching over the rim of the cistern; it is composed of iron staves rivetted to an endless link-chain, and driven by means of a cog-wheel simultaneously with the squeezing rollers. Behind these a similar transport contrivance takes off the squeezed-out wool. An iron plate fixed underneath the squeezing rollers and the feeding apparatus, and slanting towards the vat carries the superfluous liquid back into the cistern. The whole squeezing apparatus, instead of being fixed to the vat, may also be separately mounted on a movable frame. This arrangement has the advantage, that it may serve several vats according to requirement.

Indigo MLB, dyed in the hydrosulphite vat.

The above-described apparatus is worked in the following manner: The vat having been prepared, the wool (about 90 lbs in an apparatus of 800 gallons), is slowly moved about by two men under the surface of the liquid 20—30 minutes. It is then quickly lifted out of the bath with sticks or forks, and thrown upon the feeding apparatus whence it is carried to the squeezing rollers. Finally, the perforated cage is gradually raised at one end in order to remove from it the remainder of the wool.

Prussian trimming cloth.

Indigo MLB, dyed in the hydrosulphite vat.

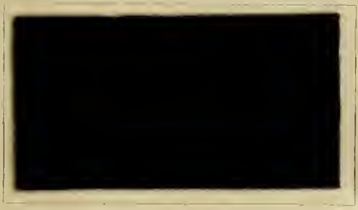
For dyeing ordinary Prussian dragoon cloth made of Cape wool the vat (of 800 gallons capacity) is prepared initially with.

$^2/_3$ gallon ammonia
3 lbs 5 oz dissolved glue
1$^3/_4$ gallons hydrosulphite O and
$^2/_3$—$^3/_4$ gallons Indigo MLB vat I,

and for further lots with

$^1/_{10}$—$^1/_5$ gallon ammonia
$^1/_2$—$^2/_3$ gallon hydrosulphite O, and
$^1/_5$—$^1/_3$ gallon Indigo MLB vat I.

Prussian Infantry Uniform Cloth.

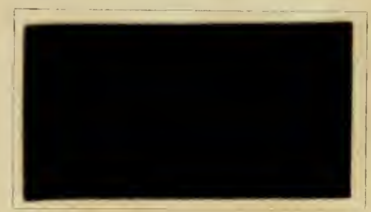


Indigo MLB, dyed in the hydrosulphite vat.

Regarding the general rules to be observed in preparing and working the glue-hydrosulphite-ammonia vat we refer to the particulars given in vol. I page 153 and 154.

Although in the following, some figures are given for a few typical examples, it is necessary to remark that these figures are not binding for all cases, but are subject to variations according to prevailing circumstances, (quality of the wool etc.). The amount of the ingredients must be determined, above all, by the general appearance and the conditions of the vat.

Prussian Dragoon cloth.



Indigo MLB, dyed in the hydrosulphite vat.

For Prussian Infantry blue which is generally produced in two dips, the following recipe is used:

$^1/_2$ gallon ammonia
3 lbs dissolved glue
2 gallons hydrosulphite O, and
2 gallons Indigo MLB vat I.

For replenishing, the following additions are made:

1 pint ammonia
2—2$^2/_3$ gallons hydrosulphite O, and
2—2$^2/_3$ gallons Indigo MLB vat I.

As a guide for preparing the vat for dyeing wool for German navy cloth in two dips, the following figures will serve:

$^1/_3$ gallon dissolved glue
1$^1/_4$—1$^3/_4$ gallons hydrosulphite O
2$^1/_2$—3 gallons Indigo MLB vat I,

and for replenishing:

$^1/_3$—$^2/_5$ gallons hydrosulphite O
$^1/_5$—1 gallon Indigo MLB vat I.

For fine cloths Indigo MLB/R may be used alone or in conjunction with Indigo MLB; such combinations are by far faster than shades produced by Indigo or topped with acid dyestuffs.

German Navy Cloth.

Indigo MLB dyed in the hydrosulphite vat.

For dyeing loose wool in a mechanical apparatus the hydrosulphite vat Hoechst is pre-eminently suitable, on account of being free from sediment. Lightblues and medium blues are easily dyed in one dip, after preparing the vat liquors in the usual manner. But as it is desirable to produce also the darkest shades in one dip in order to save time and the trouble of re-arranging the material several times over, the vat liquids are best prepared in the following manner:

The vat is first prepared, as usual, with dissolved glue, hydrosulphite and Indigo, and the apparatus then set in motion. After 10 minutes a gradual addition is made (most conveniently through a dripping funnel), of bisulphite of soda of 72° Tw., dissolved in an equal quantity of water, until the vat liquor reacts slightly acid, i. e., until the test with phenolphthaleine does not show any reddish tinge as described in vol. I page 154. Practice will soon teach the dyer by the gradual lightening of the colour of the vat, what quantity of bisulphite is required; as a rule, $^2/_5$–$^4/_5$ gallons bisulphite 72° Tw. are sufficient for 2 Cwt. material. The whole dyeing operation lasts about 30 minutes.

Indigo MLB R dyed in the hydrosulphite vat.

After dyeing, the blue is oxidized as quickly as possible by a treatment with cold water.

Through the acidifying of the liquid almost $^4/_5$ of the Indigo used are evenly and firmly fixed upon the fibre, so that it is possible to produce dark blues in a mechanical appliance in one dip by means of this method.

In the further dyeing process the dye liquid, before it can be used again, must be made neutral or weakly alkaline after each operation, i. e., the test with phenolphthaleine must again show a slight red tinge. The red colour however, must soon disappear as otherwise the bath is too alkaline and too much ammonia has been added. $^1/_5$–$^2/_5$ gallons ammonia will generally be found sufficient. (An excess of ammonia is less harmful than insufficient neutralization).

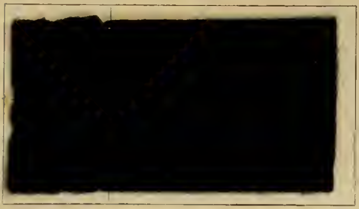
After neutralizing, the necessary quantities of Indigo vat liquid I and hydrosulphite are added to the bath, till it resumes its normal appearance.

The shades produced upon loose wool will satisfy all demands as to fastness, if carried out in an expert manner; if the wool has been well scoured and squeezed out before being oxidized these blues do not rub excessively. Moreover they will not be liable to wear grey, a peculiarity of shades produced by unskilful dyeing, especially upon badly scoured wools.

Good Indigo shades are in every respect fast to milling, and likewise to steaming; but it must be borne in mind that blue shades obtained in the hydrosulphite vat become somewhat redder and brighter by steaming and carbonising. Indigo dyed shades stand carbonising with sulphuric acid, and can be topped with other dyestuffs. This property is often made use of to the largest possible extent. In consequence of the fastness, even of light indigo shades, to wear and light, Indigo is employed as a foundation for blue and for other mixed and fancy colours, such as green,

Indigo point ground topped with
0,6% **Acid Violet 5BF**
0,15% **Fast Acid Violet R**
10% Glauber's salt, 3% sulphuric acid,
6% chrome alum.

olive, brown, grey, drab etc. For that purpose the loose wool is grounded in the vat with Indigo, to the desired depth of shade, and is then dyed over, as required, either in the loose state, or in the yarn, or even in the piece, with other dyestuffs, — mordant, developing or acid dye stuffs, — in accordance with the desired fastness.



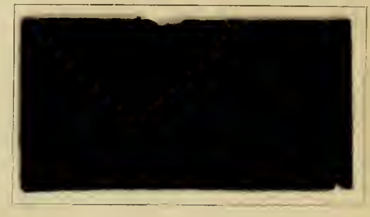
3% **Chromotrope F4B**
10% Glauber's salt. 3% sulphuric acid
2,5% bichrome, 2% lactic acid, 1,5% sulphuric acid
topped with **Indigo MLB** in the hydrosulphite vat.

In consequence of the easy and sure application of Indigo in the hydrosulphite vat, and also on account of its cheapness, it is used to an ever increasing extent for pointing (we shall refer to this in greater detail in some later chapters), and can be most highly recommended.

On the other hand, for darkening Indigo shades a foundation with fast mordant or developing dyestuffs is often used; e. g., the wool is first dyed with 3% Chromotrope F4B developed with bichrome and lactic acid, and then dyed in the vat with Indigo until the desired shade is obtained.

Redder shades of darkblues are produced in the same way by first dyeing with Alizarine Red 1WS, developing with chromium fluoride, and subsequent topping with Indigo. The blue shades thus obtained are cheaper than those produced with pure Indigo and possess a high degree of fastness to wear and light.

Next to Indigo we have to consider Alizarine Blue for the production of blue shades upon loose wool for plain-coloured goods.



3% bichrome, 2,5% tartar,
10% **Alizarine Blue SBW paste**
5% **Galleine A paste**
2×2,5% acetic acid.

Alizarine Blue, though inferior to Indigo, as regards the sum total of its properties of fastness, (especially fastness to light, in medium and lighter shades) possesses certain properties which, both for the process of manufacture and for the finished goods, are so satisfactory that generally there need not be any hesitation as to its employment for dyeing loose wool. Alizarine Blue can be easily and safely dyed on previously chrome-mordanted material and yields a beautiful blue which, both in milling and carbonising retains its fulness and depth, and whose fastness to light especially in medium to darkblues satisfies all practical demands. Consequently, cloth for caps and uniforms, overcoatings and serges can be dyed with it, unless it be desirable or demanded to use Indigo.

3% bichrome, 2,5% tartar
20% **Alizarine Blue A paste**
1,6% **Alizarine Red 1WS powder**
2×5% acetic acid.

Of the Alizarine Blue brands on the market — except Alizarine Darkblue S and SV, — those designated "S", which are supplied in paste or powder form, must be distinguished from the other brands. They represent the more soluble bisulphite compounds which are particularly suitable for those purposes where solubility is essential, viz., for apparatus and piece dyeing.

In this case, however, great attention should be paid to what has been said in vol 1, page 142, in order to make the best possible use of the colour.

On the other hand, the Alizarine S brands impart a harder handle to the wool and somewhat diminish its pliability in spinning, so that on this ground for the dyeing of loose wool they must receive less consideration.

3% bichrome, 2,5% tartar

17% Alizarine Blue A paste
6,5% Ceruleine A paste
2×2,5% acetic acid.

The various brands of Alizarine Blue are used in accordance with the desired shade; Alizarine Direct Blue B or Galleine are employed for shading off towards a bright violet; Alizarine Red, particularly 1WS powder, towards red; and Ceruleine or Alizarine Direct Green G towards green.

For especially brilliant, bright blue shades, dyed initially with Alizarine Blue, Patent Blue A, Milling Blue 2R extra and Fast Acid Violet may sometimes be used for shading off and the employment of these, up to about ½%, does not materially impair the fastness of the shade.

Full darkblue shades are produced with Alizarine and Acid Alizarine Black SE. In that case a preliminary addition of 1% oxalate of ammonia is made to the bath, and the wool, — previously mordanted in the usual manner — is dyed with 5% acetic acid; after boiling for ½ hour, a further addition of 5% acetic acid is made and boiling continued for ½ hour. The colour is finally fixed by adding ½—1% bichrome and further boiling for ½ hour.

Another mordant dyestuff to be employed for plain coloured styles is Anthrol Blue NR, which is used in the same manner as Alizarine Blue upon chrome-mordanted material. Its fastness is rather inferior to that of Alizarine Blue. It is a little more sensitive to alkalies, and also its fastness to light is not so satisfactory as that of Alizarine Blue; still the difference is almost insignificant for all practical purposes, and although not quite as reliable as Alizarine Blue in point of fastness to milling, its tendency to bleed slightly is of no consequence in plain shades.

4% bichrome, 3% tartar

25% Alizarine Dark Blue S
2×2,5% acetic acid.

3% bichrome, 2,5% tartar

1% oxalate of ammonia
10% Alizarine Blue A paste
10% Acid Alizarine Black SE paste
2×5% acetic acid
0,5% bichrome.

The fact however, that the shades dyed with Anthrol Blue do not withstand carbonisation with sulphuric acid, and are only stable to carbonisation with aluminum chloride must be regarded as a greater defect. Anthrol Blue is therefore only to be employed in such cases where the wool has been carbonised before dyeing, or is to be carbonised with aluminium chloride. For shading Anthrol Blue the same dyestuffs as were mentioned for Alizarine Blue are used.

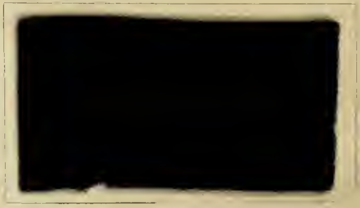
Before describing the chrome-developing dyestuffs, which are to be considered for fast blue shades, we must mention Alizarine Direct Blue B which though a genuine Alizarine dyestuff, is on the other hand also an acid dyestuff, and can therefore be used in the same manner as, and in conjunction with, chrome-developing dyestuffs.

3% bichrome, 2,5% tartar

14% **Anthrol Blue NR paste**
3% **Alizarine Blue A paste**
0,2% **Ceruleine S powder**
2×5% acetic acid.

The most valuable properties of Alizarine Direct Blue B are its very good fastness to light and the purity of its shade which, together with a satisfactory fastness to water, alkalies and milling, also to steaming and rubbing, mark this product as a most valuable one, especially for the production of bright and lighter blue shades of excellent fastness to wearing for fine qualities of cloth, either alone or in combination with mordant or chrome-developing dyestuffs.

The shades obtained with Alizarine Direct Blue B vary as regards fastness according to the mode of dyeing employed: direct acid dyed shades show a pretty high degree of fastness to water and milling, so that this application can be resorted to in many cases for dyeing loose wool for plain shades. The fastest shades however, are obtained by aftertreating the acid dyed material with bichrome. Almost as fast as these are the shades obtained on previously mordanted material. The shades produced by the various methods differ very little however from one another.



3% **Alizarine Direct Blue B**
0,25% **Alizarine Red 1WS powder**
0,1% **Alizarine Yellow GGW powder**
20% Glauber's salt; 2×2,5% acetic acid; 1% acetic acid

2,5% bichrome.

Out of the series of chrome-developing dyestuffs we recommend for blue shades for plain coloured styles: Chromotrope FB, F4B, DW, Chromotrope Blue WB, WG and, above all, Fast Mordant Blue R and B. As regards fastness to light and wear, Chromotrope FB, F4B and the Chromotrope Blue brands satisfy all demands of the trade, and possess the advantage over Anthrol Blue that they can be carbonised with sulphuric acid without any appreciable change of shade. Though bleeding slightly reddish in milling, they have the advantage over Alizarine Blue and Anthrol Blue which have to be dyed upon previously mordanted material, of being cheaper; moreover the wools so dyed are more pliable in spinning, as only one-bath is employed in dyeing. In loose wool dyeing they are most extensively used as bottom under Indigo, or for topping Indigo points (as already mentioned on page 27), but their chief application lies within the sphere of yarn and piece dyeing.

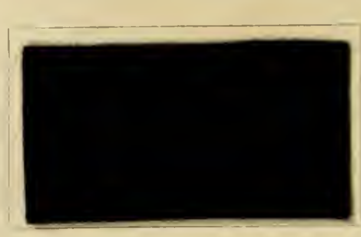
3% **Chromotrope DW**
0,3% **Acid Alizarine Grenate R**
10% Glauber's salt, 3% sulphuric acid

2% bichrome, 1% lactic acid, 2% sulphuric acid.

Chromotrope DW, though employed in like manner to Chromotrope FB and F4B. is rather superior to these products. It shares with them the advantage of preserving the quality of the wool and of cheapness, but it is faster to milling, alkalies and steaming; its fastness to light equals that of Alizarine Blue, as does also its fastness to acids and carbonising, so that it must be considered a very valuable dyestuff, most suitable for fast wool dyeing.

On account of its solubility Chromotrope DW is particularly well adapted to apparatus dyeing. When so employed, bright copper vessels and appliances are to be avoided. The injurious effect of copper upon the shade and its fastness is counteracted by addition of sulphocyanide of ammonia to the bath.

Of still greater value, however, are Fast Mordant Blue B and R. These dyestuffs, belonging to the group of developing dyestuffs, possess this advantage over the above-named Chromotropes that they have a manifold application, while their fastness properties are of a distinctly superior order. They may be developed, after dyeing in an acid bath, with bichrome or with fluoride of chrome; in the former case they require less bichrome than the Chromotropes and no lactic acid. They also yield fast shades on previously chrome-mordanted goods. It is therefore at the discretion of the dyer to use the dyestuffs as one bath colours, viz. to develop them in the acid bath or to use them in two baths, one for mordanting, and the other for dyeing.



5% **Fast Mordant Blue B**
0,6% **Acid Alizarine Violet N**
0,5% **Milling Blue 2 R extra**
10% Glauber's salt, 4% sulphuric acid
2% bichrome.

As Fast Mordant Blue R and B equalise well and are readily soluble, they are especially suitable for apparatus dyeing, and therefore preferable, when so used upon previously mordanted material, to the Alizarine Blue brands and to Anthrol Blue which are less soluble and do not equalise so well. The Fast Mordant Blue shades, by whatever method produced, are distinguished for their fastness to alkali, light, rubbing and steaming, and stand carbonising with sulphuric acid. As regards bleeding in milling, the shades obtained upon previously mordanted material and those produced by treatment with fluoride of chrome are somewhat inferior to those developed with bichrome; they are, however, sufficiently fast for plain styles. On the other hand, the colour lakes produced by these two methods are brighter and richer than those developed with bichrome. Finally, the Fast Mordant Blue shades have the advantage over the above-named blues obtained with Chromotropes, that they do not change quite as much in artificial light.

3% bichrome, 2,5% tartar
4% **Fast Mordant Blue B**
2×5% acetic acid
0,5% bichrome.

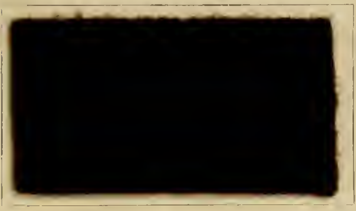
Fast Mordant Blue R and B are therefore destined to play an important part in fast wool dyeing. In their employment upon previously mordanted material the same dyestuffs as named in the case of Alizarine Blue, also the latter itself and Anthrol Blue, can be used for shading. As developing dyestuffs they can be combined with Alizarine Red 1 WS, Acid Alizarine Brown, Alizarine Yellow and other chrome developing dyestuffs, which are developed with bichrome, and with Acid Alizarine Blue, Acid Alizarine Green, Ceruleine, Alizarine Red, Alizarine Yellow for developing with chromium fluoride. In all cases auxiliary dyestuffs, such as Patent Blue A, Milling Blue, Fast Acid Violet, are permissible in small quantities.

Fast Mordant Blue is of special value in combination with Indigo. Suitable as a bottom under Indigo in the same manner as the Chromotrope brands, it is still more suited for topping Indigo shades, as it can be developed with chromium fluoride or, when developed with bichrome, requires weaker chrome baths than are necessary for the full development of Chromotropes, which latter are therefore liable to destroy part of the Indigo bottom by oxidation.

Other combinations for the production of blue shades for plain shades, such as Alizarine Blue or Galleine with logwood, have nowadays hardly any justification at all in view of the choice of dyestuffs hitherto described. Formerly they were undoubtedly much used, as they were considerably cheaper than Alizarine Blue and Indigo. But the reduced price of both, especially of the latter, has placed this consideration entirely into the back ground and in point of cost the older combinations cannot compare any longer with the Developing Blue, Fast Mordant Blue and Chromotrope brands. To this must be added the fact that the latter are considerably superior in fastness, especially in fastness to light. Therefore these combinations ought to be restricted as far as possible; they may be employed for backs or bottom wefts of heavy Eskimoes and presidents, but should not be used for the face of these materials.

Brown.

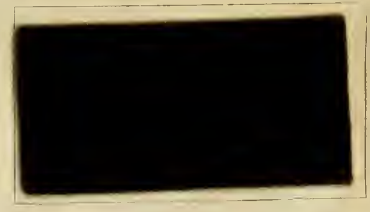
The first fast brown among the range of mordant dyestuffs for dyeing loose wool intended for plain shades is the Alizarine Brown. It is put upon the market in a number of brands varying from a more or less green to red hue. Very stable to milling, it changes but little in steaming, is eminently fast to wearing and light, also to perspiration and alkali. The only drawback is that Alizarine Brown cannot be carbonised with sulphuric acid, so that it can only be considered for carbonisation with aluminium chloride.



3% bichrome, 2,5% tartar
15% Alizarine Brown paste
2,5% Alizarine Orange N paste
1,5% Mordant Yellow O
2×4% acetic acid.

Alizarine Brown is dyed in two baths; the material is first mordanted with chrome and then dyed with the addition of acetic acid; the shade is fully developed by boiling for 1½ hours. It may be combined with Mordant Yellow O or Acid Alizarine Yellow RC, Alizarine Red 1 W or 2 BW, Alizarine Orange, Alizarine Blue A or Alizarine Darkblue S and Ceruleine paste A.

Much faster to carbonising are the brown shades produced upon previously mordanted goods with Alizarine Orange in combination with Acid Alizarine Black SE. These are dyed on a bichrome-sulphuric acid mordant, or a bichrome-lactic acid-sulphuric acid mordant, and the dyeing operation is finished up by the addition of ¼—½% bichrome, in order to increase the fastness to milling. Both the above-named dyestuffs, however, can also be used upon unmordanted wool in an acid bath for shading, in conjunction with Alizarine Red 1 WS and Mordant Yellow O; they are developed in this case with bichrome. These shades are fairly fast to carbonising, very fast to milling and light, and are cheaper than those obtained with Alizarine Brown.



3% bichrome, 2,5% tartar
4% Alizarine Brown pasta
2% Ceruleine A paste
1,4% Alizarine Darkblue S
4% Mordant Yellow O
2% acetic acid.

In respect of cheapness and fastness Acid Alizarine Brown, belonging to the group of developing dyestuffs, of which the brands R, B, BB, RP and T have been put on market is superior to Alizarine Brown. The one-bath method used for Acid Alizarine Brown effects a better preservation of the quality of the wool, and the resulting shades are as fast to light and wearing as those obtained with Alizarine Brown; they even surpass the latter in fastness to alkali, milling and steaming and, above all, to acid, so that such shades may be carbonised with sulphuric acid.

Austrian Artillery Cloth

6 % Acid Alizarine Brown B
0,5 % Ceruleine BWR
1 % Mordant Yellow O
10 % Glauber's salt, 3 % sulphuric acid
3 % bichrome.

1,75 % Acid Alizarine Brown BB
2 % Mordant Yellow O
0,25 % Acid Alizarine Black SE paste
10 % Glauber's salt, 2 % acetic acid, 2 % sulphuric acid
2,5 % bichrome.

Acid Alizarine Brown is dyed in a sulphuric acid bath and then developed with bichrome. Care must be taken not to use too big a volume of dyeliquid nor to make the latter too acid; finally not too much bichrome is to be used, as this is liable to produce lighter shades. Acid Alizarine Brown can also be dyed with acetic acid, whereby fuller and redder shades are obtained than in a sulphuric acid bath, these shades, however, are inferior in fastness to milling and light to those dyed with sulphuric acid.

Acid Alizarine Brown is not affected by metals, except by iron, and as it is readily soluble and equalizes well, it is eminently suitable for apparatus dyeing. Since, however, the dyebath does not entirely exhaust, the dyeing and chroming operations are generally carried out in 2 separate baths, both of which are then used continually.

Acid Alizarine Brown is shaded off with Mordant Yellow, Acid Alizarine Yellow RC, Alizarine Red 1 WS, Acid Alizarine Grenade R, Acid Alizarine Violet N, Ceruleine B and BWR, Fast Mordant Blue B and R, Acid Alizarine Black SE, SN and other fast chrome developing dyestuffs. Patent Blue A, Fast Acid Violet R, A 2 R, Milling Blue 2 R extra, Acid Alizarine Grey G etc. may also be used in smaller quantities for dyeing to shade.

A large variety of brown shades are produced upon an Indigo point with Acid Alizarine Brown in combination with the above-named dyestuffs.

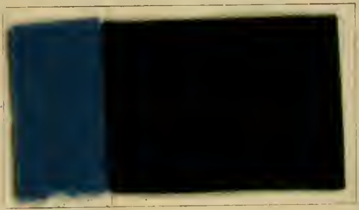
On account of these properties, Alizarine Brown must be regarded as surpassed by Acid Alizarine Brown. For this reason also the other combinations of brown, such as that of Alizarine Red and Alizarine Orange with logwood and Fustic, Brazil and Barwood have no longer

Upon Indigo ground:
4,5 % Acid Alizarine Brown B
1,7 % Alizarine Red 1 WS powder
1,75 % Mordant Yellow O
10 % Glauber's salt, 3 % sulphuric acid
3,5 % bichrome, 3 % lactic acid.

0,75 % Acid Alizarine Grenade R
0,7 % Mordant Yellow O
0,54 % Fast Mordant Blue B
10 % Glauber's salt, 3 % sulphuric acid
2 % bichrome.

any justification. They are much inferior in fastness to the shades obtained with Acid Alizarine Brown, and as they are in no wise cheaper, they ought not to be used any more in an up-to-date dyeworks.

A most advantageous combination for the production of the various brown shades, especially those approaching brown-drab, is that of Acid Alizarine Grenade R, Mordant Yellow O and Fast Mordant Blue B or R; the latter may also be replaced by Acid Alizarine Blueblack B and 3B and Acid Alizarine Grey G. All these dyestuffs are easily soluble, equalize well, and show equally satisfactory fastness properties, so that the shades obtained with them satisfy all demands, both as regards various stages of manufacture, and as finished goods. Moreover these dyestuffs are especially cheap.



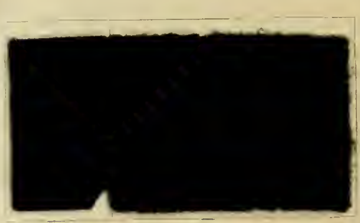
Upon **Indigo ground:**
0,5% **Acid Alizarine Grey G**
0,4% **Patent Blue A**
3% **Mordant Yellow O**
10% Glauber's salt, 5% acetic acid; 2% sulphuric acid
3% **bichrome,** 2,5% lactic acid.

Green.

Plain Green shades are dyed almost exclusively for uniform cloths, cap material, carriage cloths, etc.

They are best produced by first pointing the wool with Indigo in the fermentation or hydrosulphite vat, and then topping with fast dyestuffs. To obtain bright green shades, Mordant Yellow O, Acid Alizarine Yellow RC, or Alizarine Yellow GGW are used, and if required, a small addition of Patent Blue A is also permissible for especially bright effects.

Upon **Indigo ground:**
1,5% **Chromotrope DW**
2,2% **Mordant Yellow O**
10% Glauber's salt, 3% sulphuric acid.
3% bichrome, 2,5% lactic acid; 1% sulphuric acid.



For darker green shades the Indigo bottomed wool is topped with blue dyestuffs, such as Chromotrope DW, F4B and Fast Mordant Blue B or R, aided by some yellow dyestuffs. Acid Alizarine Grey G, Acid Alizarine Blueblack 3B and Acid Alizarine Green G serve as darkening ingredients.

In most greens produced upon Indigo bottom the amount of Indigo preponderates so that the shades so obtained possess every degree of fastness that may be demanded of them.

If it is intended to work without Indigo, fast green shades are obtained by means of Alizarine Direct Green G or Ceruleine in combination with Alizarine Blue or Fast Mordant Blue B and fast yellow dyestuffs, such as Mordant Yellow O, Alizarine Yellow GGW, and Acid Alizarine Yellow RC.

Alizarine Direct Green G, is an Alizarine dyestuff which can be applied both to previously mordanted wool, and in an acid bath to unmordanted wool, either with or without aftertreatment with bichrome or fluoride of chrome; it is a bright, blueish-green wool dyestuff, distinguished for its superior fastness to light, also for satisfactory fastness to water, Austrian Official Green Cloth.

3 % bichrome, 2,5 % tartar

3 % **Ceruleine S powder**
1,7 % **Fast Mordant Blue B**
0,4 % **Patent Blue A**
0,15 % **Acid Alizarine Yellow RC**
5 % acetic acid; 5 % acetic acid.

2,5 % **Alizarine Direct Green G**
1 % **Mordant Yellow O**
1 % **Fast Mordant Blue B**
20 % Glauber's salt, 2×2,5 % acetic acid; 2 % sulphuric acid.

2,5 % bichrome.

alkali and milling. In its tinctorial and fastness properties — according to the process employed for dyeing — it resembles the Alizarine Direct Blue B mentioned on page 31.

Alizarine Direct Green G, owing to its great fastness to light and wearing, also on account of the purity of its shade, is suitable for the production of bright green shades, as are required or uniforms and carriage cloths. For shading off towards blue Alizarine Direct Blue B must be used, and towards yellow one of the above-named yellow dyestuffs.

Ceruleine B paste, DW conc., and BWR powder are also specially suitable for bright green shades. Particularly brilliant green shades require the addition of a little Patent Blue A for shading purposes, together with the Yellow dyestuff. The combinations are dyed upon chrome-tartar mordant; they are fairly fast to light and wearing, change little in milling and steaming, and, when properly treated, stand carbonising with sulphuric acid.

3 % bichrome, 2,5 % tartar

10 % **Ceruleine A paste**
1 % **Alizarine Brown paste**
0,75 % **Mordant Yellow O**
2×2,5 % acetic acid.

0,75 % **Chromotrope F4B**
0,8 % **Patent Blue A**
0,75 % **Mordant Yellow O**
10 % Glauber's salt, 3 % sulphuric acid

2,5 % bichrome, 1 % lactic acid; 1 % sulphuric acid.

For darker green shades the duller Ceruleine paste A or the similar brands: Ceruleine conc., S, S conc. are used in combination with Alizarine Brown and the above-named dyestuffs. Also Alizarine Green S, though not quite so fast to carbonising and somewhat sensitive to alkali, may be used in such mixtures.

A cheaper method than the above is to produce green shades by combinations of chrome developing dyestuffs, such as Chromotrope F4B, DW, S, Fast Mordant Blue B and R, with the above-named fast Yellow dyestuffs, and if necessary, with Alizarine Direct Green G or else Ceruleine BWR powder. For darkening in such cases Acid Alizarine Grey G, Acid Alizarine Blueblack 3B, Acid Alizarine Black SE and SN may be used, whereas Patent Blue A or Alizarine Direct Blue B should be chosen if greater brightness is demanded. The green shades so obtained are cheaper than those dyed upon mordants;

moreover the solubility of the products used makes them suitable for mechanical apparatus dyeing. Their fastness to wearing and light equals that of the shades produced with mordant dyestuffs, though it may not quite reach that of green shades obtained upon Indigo bottom.

The latter process is often carried out by dyeing the Indigo bottomed goods in the piece to the required shade; we shall again refer to this application in the chapters on piece dyeing.

Red.

Red shades on loose wool for plain styles are of minor importance compared to the other colours hitherto described. Solid reds are sometimes employed for carriage cloths and, as madder red, for uniforms in several armies.

10% alum; 3% tartar, 2% oxalic acid
8% Alizarine Red 2BW paste
5% Alizarine Orange N paste
1% tannin, 1% acetate of lime; 2% acetic acid.

The so called madder red upon loose wool was formerly produced exclusively by means of madder. The great difference in price however, between the natural product and artificial Alizarine has resulted in the almost entire disregard of the former; this shade is now dyed everywhere with Alizarine Red, unless special circumstances demand the use of madder.

Alizarine Red is used for the production of madder shades upon Alum Mordant with the addition of tannin and acetate of lime, as was already stated in the discussion of the general methods of dyeing in Vol. I, page 135. It is therefore superfluous to enter upon the subject here in greater detail; we will not fail however, to point out once more, that in order to obtain satisfactory results the mordanting and dyeing cisterns must be free from other dyestuffs and impurities, and that the chemicals and water used must contain no iron.

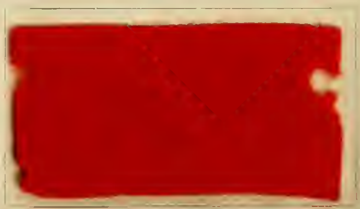
Madder shades are best obtained with Alizarine Red 2BW or with the similar brand 4FW which is a little yellower, and 1W which is rather bluer. For shading Alizarine Orange N may be used for yellowish reds, and Alizarine Grenade R and Ceruleine for blueish reds. For very bright blueish shades Scarlet B extra is most serviceable.

Madder shades can also be produced, and more cheaply, with Alizarine Red 1WS and 3WS, if necessary, with the addition of some Alizarine Orange N, by the one bath method. The wool is dyed in a bath containing the dyestuff, 10% Glauber's salt and 3% sulphuric acid, and then developed with 10—12% alum. However, this one bath red is liable to change more in milling than the one obtained on previously mordanted material.

The reds obtained by both methods are very fast to wearing; they also withstand perspiration, alkalies and light, and are fast to rubbing. It must be borne in mind in manufacturing however, that the reds dyed by either method with Alizarine Red can only be carbonised with aluminium chloride.

The same drawback is shown by the blue-red shades obtained with the above-named Alizarine Red brands upon chrome mordant; these however are superior as regards fastness to bleeding and milling than the shades upon alum mordant. For that purpose the Alizarine

10% Alum: 3% tartar, 2% oxalic acid
4% Alizarine Red 1WS powder
0,25% Scarlet B extra
1% tannin, 1% acetate of lime; 2% acetic acid.



Red shades are dyed in the usual manner upon chrome-tartar mordant with the addition of acetic acid. Alizarine Red 1 WS and 3 WS however are best dyed on bichrome-sulphuric acid mordant (compare Vol. I, page 135), and it is further necessary to keep the dyebath more acid than for the other brands.

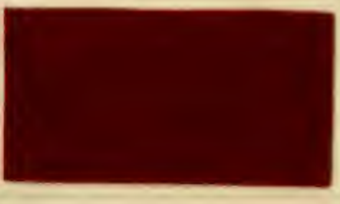
Lastly, Alizarine Red 1 WS, 3 WS and PS can also be dyed in a sulphuric acid bath, like the developing dyestuffs, and are then developed by a subsequent addition of alum, fluoride of chrome, or bichrome. This method, first recommended by the Farbwerke Hoechst, brings about a better preservation of the material, and is cheaper and more easily worked since only one bath is used. Furthermore, the shades so obtained are faster to milling and bleeding than the corresponding shades on previously mordanted material; only in milling they change more under the influence of the alkali than the shades obtained on previously mordanted material.

4% **Alizarine Red 1 WS powder**
0,125% **Mordant Yellow O**
0,125% **Patent Blue A**
10% Glauber's salt, 4% sulphuric acid
3% bichrome.

Alizarine Red PS is very sensitive to an excess of bichrome; it is therefore advisable not to use more than $^1/_4$—$^1/_2$% of the latter or to use in its place fluoride of chrome.

All shades produced with Alizarine Red have, however, the disadvantage that they cannot be carbonised with sulphuric acid, so that in using them the carbonising process is restricted to aluminium chloride. This disadvantage does not attach to the shades produced by means of developing dyestuffs, though these do not quite equal the Alizarine Red shades obtained on previously mordanted material, in point of purity and brilliancy. Nevertheless, the simplicity of application and cheapness, together with equal, and partly superior fastness properties of the developing dyestuffs have secured their introduction in fast wool dyeing, despite their less beautiful shade.

The red dyestuffs to be considered for dyeing loose wool are Dianil Fast Red PH, Acid Alizarine Red G and B, to which may be added as auxiliaries toward blue Acid Alizarine Grenade R and Acid Alizarine Violet N, whilst Mordant Yellow O and Acid Alizarine Yellow RC may be taken into account for shading off towards the yellow side.



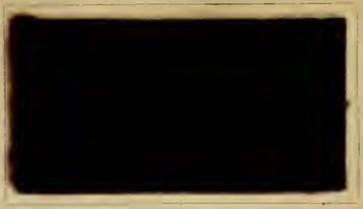
3% **Dianil Fast Red PH**
0,2% **Rosazeine B**
20% Glauber's salt, 5% acetate of ammonia
2% acetic acid, 1% sulphuric acid
2,5% bichrome.

Amongst the above-named dyestuffs Dianil Fast Red PH, as its name implies, occupies a position peculiar to itself. This product belongs to the series of Dianil dyestuffs, however, it is also most valuable in wool dyeing as a developing dyestuff, whereas it has little interest as a direct colour on wool.

Dianil Fast Red PH is first dyed with the addition of 20% Glauber's salt and 5–10% acetate of ammonia, and developed with chromium fluoride or bichrome. As the dyestuff is quickly taken up by the fibre, strong acids are to be avoided and the dyebath must not be heated too rapidly. The chrome lake has a similar shade to that of madder red, and is distinguished for high degrees of fastness. It is very fast to light, milling and alkali, and

Austrian cavalry cloth.

3,8 % **Acid Alizarine Red G**
0,05 % **Mordant Yellow O**
10 % Glauber's salt, 4 % sulphuric acid
3 % bichrome.



2 % **Acid Alizarine Grenade R**
2 % **Acid Alizarine Violet N**
10 % Glauber's salt, 4 % sulphuric acid
2,5 % bichrome.

very stable to steaming and carbonising with sulphuric acid. The lake obtained with bichrome is even superior as regards fastness to bleeding to that developed with chromium fluoride. The greatest defect of Dianil Fast Red PH is, that it does not equalize. Although this drawback is not of great consequence in loose wool dyeing, still it is advisable to work carefully in order to avoid uneven shades.

Acid Alizarine Red G and B do not show the same defect. Equalising well, they can be dyed with the addition of Glauber's salt and sulphuric acid, and then developed with bichrome. Considering their easy solubility and good equalising capacity, both brands are particularly suitable for apparatus dyeing, in which case, however, iron apparatus must not be used.

The shades obtained by means of Acid Alizarine Red are very fast to rubbing, in which respect they are better than those obtained with Alizarine Red. They also equal the latter in fastness to light, are fairly fast to alkalies, and stand carbonising with sulphuric acid and the subsequent treatments without appreciably changing their shade. Only in heavy milling both dyestuffs, especially the B brand, lose somewhat in intensity; on the other hand, they equal in fastness to bleeding the alum developed Alizarine Red 1 WS, and can be regarded in that respect as perfectly serviceable for dyeing loose wool for plain styles.

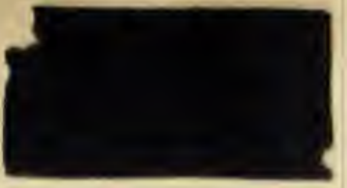
It is thus evident that also for Red shades the developing dyestuffs have entered into serious competition with the Alizarine dyestuffs.

Drab.

Drab shades are dyed comparatively little upon loose wool for plain styles. They are mostly required for grey and drab liveries and carriage cloths.

The greatest degree of fastness of such shades is obtained by grounding with Indigo as far as the depth of shade permits, and then topping them with fast Chrome Developing dyestuffs, Acid Alizarine Grey G, Acid Alizarine Red G, Alizarine Red 1 WS, Acid Alizarine Brown B, BB, T, Mordant Yellow O, i. e, such dyestuffs as possess good equalising properties, so as to effect the greatest possible evenness upon the wool

Upon **Indigo ground:**
0,135 % **Acid Alizarine Grey G**
0,1 % **Alizarine Red 1 WS powder**
0,07 % **Alizarine Yellow GGW powder**
10 % Glauber's salt, 5 % acetic acid
0,5 % bichrome, 0,5 % lactic acid.



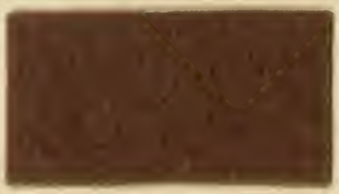
0,5 % oxalate of ammonia
0,4 % **Acid Alizarine Black SE powder**
0,07 % **Mordant Yellow O**
10 % Glauber's salt, 3 % acetic acid; 1 % sulphuric acid
1,25 % bichrome.

consistent with the usually small quantities of dyestuff requisite for the initial dyeing operation.

If it is desired to work without Indigo ground, the blue shade can be conveniently produced with Acid Alizarine Black SE, Acid Alizarine Blueblack B or 3 B, Fast Mordant Blue B or R, which may either be subdued with Acid Alizarine Brown, Mordant Yellow O, Acid Alizarine Red G or, if necessary, be brightened by adding some Patent Blue A, Milling Blue 2 R extra, Fast Acid Violet A 2 R or R.

Drab shades requiring very little of a blueish cast are grounded with Acid Alizarine Brown which is shaded off with the above-named red, grey or black and yellow dyestuffs.

The shades so obtained possess a satisfactory fastness to light and wearing, they are fast to milling and stand the subsequent operations of steaming, pressing and carbonising without appreciable change of shade.



0,32 % **Acid Alizarine Brown BB**
0,07 % **Acid Alizarine Black SE powder**
0,06 % **Mordant Yellow O**
10 % Glauber's salt, 3 % acetic acid, 1 % sulphuric acid
1,25 % bichrome.

Fast Drab shades can also be produced with Alizarine dyestuffs. For that purpose the material is dyed, according to shade, with Alizarine Brown or Alizarine Blue, and an addition of Acid Alizarine Yellow RC or Mordant Yellow O, Alizarine Red 1 WS, Ceruleine, Fast Mordant Blue R, B, and Acid Alizarine Black SE upon previously mordanted material. When using the three last named brands, an addition of $^1/_4$ % bichrome is made at the close of the dyeing operation.

Where fastness to carbonising with sulphuric acid is of importance, it is necessary to replace Alizarine Brown by Alizarine Orange which, in combination with Acid Alizarine Black SE, is very suitable for the production of brownish and drab shades.

Seeing, however, that in dyeing light shades to pattern with Alizarine dyestuffs a great amount of skill is required, these combinations are not aften used, especially since the combinations with Alizarine Brown cannot be carbonised with sulphuric acid, and shades produced with Alizarine dyestuffs are generally liable to change more in milling than those obtained with developing dyestuffs. Finally, the latter are cheaper and the wools dyed with them remain freer and more pliable.

2 % bichrome, 1,5 % tartar
0,16 % **Alizarine Brown paste**
0,09 % **Acid Alizarine Black SE paste**
0,036 % **Acid Alizarine Yellow RC**
5 % acetate of ammonia, 1 % acetic acid.

The Dyeing of loose Wool for Multi-coloured Goods.

In the case of loose wool for multi-coloured goods, whether made with melange effects or, like Buckskins, with weaving effects, much greater demands upon the fastness of the colours are made than for plain styles, for in this case the colours must in no wise tinge or smudge the concomitant colours — often very light shades or white — during the process of milling, carbonising or subsequent treatments. Consequently, several dyestuffs that can very well be used for single-coloured goods, are unsuitable for loose wool intended for Buckskins and melanges.

On the other hand, the claims made upon these goods as to fastness in wearing differ widely, inasmuch as very fine qualities, for which those claims are fully justified, often stand side by side with ordinary goods, the principal feature of which is cheapness, or with ladies' cloths which have to undergo only light milling and for which relatively brighter shades are desired. For that reason the range of dyestuffs to be considered, as well as the number of combinations of shades required, is much larger than those of the previous chapter.

The tendency of the present fashion involves the frequent working in of silk, artificial silk, cotton, ramie, linen etc., effects both in white and colours. In such cases it is imperative that the coloured wools do not bleed into those fibres during the milling and finishing operations, whilst the colours used for these fibres must, of course, likewise be fast in their various aftertreatments.

The following chapter treats of the different groups of colours and the combinations of dyestuffs. In view of the above remarks concerning the varied demands and the great variety of dyestuffs, it is of course impossible to give an exhaustive account of all dyestuffs that can possibly be considered, and only the best combinations will be mentioned. It must be left to the judgment of the dyer, in each particular circumstance, to make use of any given combination, or of other combinations either cheaper or in other respects less deficient and safer.

White and Pearl.

White and so-called pearl shades, where the wool receives only a delicate tinge, play a great part in the manufacture of fancy goods. They are most frequently used in conjunction with darker colours, in order to improve the effect by way of contrast, and to enhance the appearance.

In consequence of a certain natural yellowish colouring matter, all white wool appears more or less yellowish; therefore, and as a matter of course, only those kinds of wool are chosen for white and pearl shades which contain the smallest possible amount of this colouring matter. In many cases the employment of such wool in its natural state suffices; very often, however, the natural shade of the wool is inadequate for bringing out in the strongest possible manner the contrast effect. It is then the task of the dyer to destroy as much as possible the yellowish hue of the wool.

That object is attained either by destroying the colouring matter, or by topping the wool with a dyestuff complementary to yellow, viz: blue violet, or else — which is mostly done — by combining those two methods.

The destruction of the yellowish colouring matter of wool, i. e., the bleaching of wool, can be effected either by a process of oxidation or of reduction.

The white shade obtained by means of oxidising agents is considerably more lasting than that produced by the process of reduction, in which the natural colouring matter is apparently only transformed into a kind of leuco-compound which, under the influence of the atmospheric oxygen and sunlight is changed back again more or less completely into the original colouring matter. Contrariwise, the processes of oxidation possess the advantage of yielding a more stable and better white, but also the disadvantage, that their employment is considerably more expensive than the processes of reduction, so that they are only to be considered for better kinds of goods.

A good oxidising process consists in first treating the wool with a solution of permanganate of potash, and then removing the red brown shade again in a second bath prepared with bisulphite and sulphuric acid. This older two-bath-method has been largely superseded by that, recently brought into vogue, of bleaching with peroxide of hydrogen, which consists in preparing the bleaching bath with about 30–50% of the commercial solution of peroxide of hydrogen of 3% and as much ammonia as will cause the liquid to have a slight alkaline reaction; then entering the wool, leaving it for some time in the bath, while the temperature is slowly raised to 167° F., and finally rinsing it well.

Still more advantageous and cheaper, is the employment of peroxide of soda, which excels peroxide of hydrogen also in point of stability. The working with peroxide of soda is as follows: To the bleaching bath prepared with cold water are added 25½—55 lbs. sulphuric acid 168° Tw. for each 200 gallons water, and 22–44 lbs. peroxide of soda slowly dissolved in it while being stirred. The excess of sulphuric acid is neutralized with ammonia, the wool entered, and the temperature slowly raised to 122–140° F. It is then left for several hours in the bleaching bath, and lastly well rinsed. In the bleaching bath prepared with peroxide of soda the wool may be simultaneously shaded off with Fast Acid Violet A 2 R for reddish shades, with Fast Acid Violet B for violet shades, and with Fast Acid Blue R for blueish shades of white and pearl, thereby saving a second dyebath.

A much more frequent use is made of the reducing action of sulphurous acid than of oxidising agents for producing white. The oldest way of its employment is bleaching in the sulphur box or stove. With that object the well washed wool is brought into a soap bath, to which, for shading off purposes, are added small quantities of chemically pure Methyl Violet 2 B or 6 B; after an even tinting assisted by heating the bath to 104–122° F, has been effected, the wool is hydroextracted and spread out upon racks in the sulphur chamber, and subjected to the action of the sulphurous acid generated by the burning of sulphur. Nowadays this procedure is probably only followed for loose wool in those dyeworks where the sulphur stoves are also utilized for other purposes.

At the present time loose wool is mostly stoved wet. The most suitable ingredients for this application are our Bisulphite crystals. The bath is prepared for 220 lbs. wool with about 600 gallons water of 104–122° F, 15½—17¾ lbs. dissolved bisulphite crystals and 5½ lbs. sulphuric acid 169° Tw; after it is stirred, the scoured and well wetted material is entered and left in the fluid for an hour; the bleaching process is then complete.

As a rule this white is shaded off with Methyl Violet direct in the bleaching fluid; for very reddish shades Rosazeine O is resorted to. Faster, if not quite so brilliant, shades are obtained by using Fast Acid Violet A 2 R, B and Fast Acid Blue R in lieu of Methyl Violet. Where dyeing and bleaching are done together, it is necessary to work the material well in order to effect an even absorption of the dyestuffs.

In using Fast Acid dyestuffs, the best results as regards fastness, purity and evenness are ensured by first fixing the dyestuffs at the boil in an acetic acid or sulphuric acid bath, and then bleaching the wool by subsequent treatment in the bisulphite bath.

In sampling, regard must be had to the fact that the sulphur whites obtained by the above-named methods, especially when Methyl Violets have been used for shading, change their shade considerably in the further manipulation of the wool, especially in milling and steaming.

An eminently fast white is produced by means of hydrosulphite as bleaching agent, with Indigo MLB R for shading, the same being specially adapted for that purpose on account of its reddish hue. In that case an ordinary wool dyeing cistern capable of holding about 400–600 gallons is filled with water of 104–122° F., and 1–1½ gallons Hydrosulphite O (or the solution of 1 lb. 10 oz. to 2 lbs. 3 oz. Hydrosulphite conc powder), ⅞–1¾ pints ammonia, and ⅓–⅞ gills Indigo MLB/R Vat I slightly diluted with Hydrosulphite. The whole being well stirred, the wool is entered, well worked through, and left in the liquid for ¹/₂—1 hour. It is then taken out and squeezed. Where no squeezing apparatus is available, the vat liquid must be removed as speedily as possible by hydroextraction, whereby the addition of some water is of advantage.

For stronger pearl and silver shades more Indigo must be added to the bath, i. e., the wool is treated in a weak hydrosulphite vat and, if necessary, shaded off by topping with Fast Acid Violet.

The white and pearl shades produced with hydrosulphite and Indigo MLB/R or MLB are to be regarded as the fastest ones; they are fast to milling and light, and stand the subsequent operations of manufacture without appreciable change.

Pearl and silver shades are often produced by merely dyeing the wool with the colours complementary to its yellowish hue, without destroying the latter by any bleaching process. If, for special reasons, the dyeing with Indigo MLB/R which bleaches the wool at the same time, is not desirable, the above-mentioned Fast Acid dyestuffs and Patent Blue A are to be recommended as the next best dyestuffs, as they surpass by far in fastness to light the basic dyestuffs, such as Methyl Violet, Magenta, Victoria Blue. Light shades requiring but small quantities for that purpose, the question of price ought to be of no consideration, even for cheap goods; least of all should white and pearl shades be produced with cochineal and Indigo carmine, or cudbear and pensée lake on a chloride of tin mordant.

Fancy shades.

Fancy shades are much more used in the production of Buckskins and Melanges than in the manufacture of plain cloths.

For the fastest shades Indigo is always used as bottom, for Indigo shades, even light ones, are very fast to light, whilst under equal circumstances, even the fastest blue dyestuffs as, e. g., Alizarine Blue do not possess this property in the same degree. It is well known that shades are the less fast to light the smaller the amount of dyestuff used, and whereas the series of yellow, red and brown dyestuffs includes products which satisfy also in light shades all the most exacting demands as to fastness to light, Indigo alone of all blue dyestuffs will suffice in this respect.

For fancy shades, after grounding the wool with Indigo in the hydrosulphite vat, hardly anything but yellow, red, brown and grey is necessary. Dyestuffs suitable for that purpose are: Alizarine Yellow GGW, Mordant Yellow O, Alizarine Red 1WS, Acid Alizarine Grenade R, Alizarine Brown B, and Acid Alizarine Grey G. As auxiliaries may be used in small quantities for shading: Patent Blue A, Fast Acid Blue B, Milling Blue 2R extra, Fast Acid Violet B, A2R, R, Acid Rosamine A. The above-named dyestuffs are dyed with the addition of Glauber's salt and acetic acid to the dyebath, and subsequently developed with bichrome and lactic acid, the amounts of which vary between 0,1 and 1%, according to the quantities of dyestuff employed. Dyeing in a sulphuric acid bath is to be avoided, as the Indigo ground is easily affected by the chroming process, moreover it is also liable to impair the fastness to light, by some free chromic acid remaining on the wool fibre. A considerable protection of the Indigo ground is brought about by the additional use of lactic acid in developing.

In working only with acetic acid, it is easy to dye the shades to pattern; they come up even, provided the wool has been well scoured and evenly bottomed with Indigo, and they will satisfy all demands that may be made upon them for fastness. Seeing that they are obtained in one bath (apart from the Indigo ground) the cost of production is very small especially when the pliability in spinning is taken into consideration.

The combination of Indigo with mordant dyestuffs for fancy shades is less to be recommended, since it requires a second bath; it is therefore, more expensive and more liable to impair the wool fibre. Should it nevertheless be desirable to make use of this process, it is advisable not to work in such a manner as to ground the wool first with Indigo, and then to mordant and dye it, but rather, to boil the wool first with bichrome and tartar, then to wash it well; then to apply the Indigo in the vat, and finally to dye it in a fresh bath to pattern with Alizarine dyestuffs. In the former case the Indigo ground would be greatly impaired by the mordanting with bichrome and tartar, and especially with sulphuric acid, so that the operation would not only be an irrational one, but would also yield uneven and dull shades, whereas by the latter method the Indigo ground can be preserved intact.

Where the demands respecting fastness are less severe, or for darker shades or also for shades which require only a small amount of blue, the combinations with Alizarine dyestuffs are available.

As mordant in such cases bichrome-tartar is mostly used, because it offers the greatest guarantee for mordanting and dyeing the material evenly. For very light shades not more than 1% bichrome and 1% tartar are taken, for medium shades not above 2% bichrome and 2% tartar; the reason for keeping the ingredients as low as possible is that an excess of mordant affects the dyestuffs unfavourably, owing to the oxidising reaction of the chromic acid fixed upon the fibre.

1. Brown Drab (70%)
2% bichrome, 2% tartar
2,8% **Alizarine Brown paste**
0,5% **Alizarine Blue A paste**
0,21% **Mordant Yellow O**
5% acetic acid.

2. Pearl (15%).
1% bichrome, 1% tartar
0,6% **Alizarine Blue A paste**
0,012% **Alizarine Red 1 WS powder**
0,1% **Acid Alizarine Grey G**
5% acetic acid.

3. Light Silver (15%).
Indigo dyed in the hydrosulphite vat with **Indigo MLB Vat I.**

The combinations of mordant dyestuffs most frequently used contain, according to the required shade: Alizarine Blue, Alizarine Brown, Alizarine Yellow, Alizarine Red 1WS, Ceruleine, Mordant Yellow O and Alizarine Yellow GGW. The shades so obtained are easily dyed to pattern, as they change but little in milling and steaming. They satisfy most demands as to fastness to wearing and light.

1. Pearl:
0,1% **Fast Acid Blue R**
10% Glauber's salt, 3% acetic acid; 2% sulphuric acid.

2. Dark Olive:
1,85% **Acid Alizarine Yellow RC**
0,375% **Alizarine Red 1 WS powder**
1,5% **Acid Alizarine Black R**
10% Glauber's salt, 5% acetic acid; 2% sulphuric acid
2% bichrome.

3. Coffee Brown:
2% **Acid Alizarine Brown B**
0,2% **Acid Alizarine Black R**
0,3% **Alizarine Red 1 WS powder**
1,4% **Mordant Yellow O**
10% Glauber's salt, 3% sulphuric acid
3% bichrome

4. Brown Olive:
2,45% **Acid Alizarine Brown B**
0,25% **Acid Alizarine Black R**
0,5% **Alizarine Red 1 WS powder**
2% **Mordant Yellow O**
10% Glauber's salt, 3% sulphuric acid
3% bichrome.

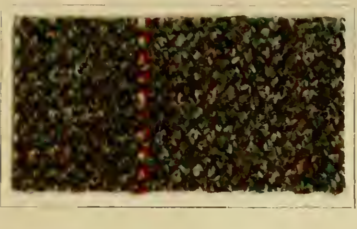
5. Light Olive:
0,5% **Acid Alizarine Grey G**
0,225% **Acid Alizarine Grenade R**
0,4% **Mordant Yellow O**
10% Glauber's salt, 5% acetic acid; 2% sulphuric acid
1% bichrome.

On account of their simpler mode of dyeing, however, fancy shades produced with the Chrome Developing dyestuffs are in most cases preferable to those obtained with Alizarine dyestuffs. When properly selected, they equal and partly excel as regards fastness to light and wearing those produced with Alizarine dyestuffs; moreover since they are only dyed in one bath they are worked with greater ease and more quickly, whilst the wool is better preserved.

As they scarcely change the shade when properly milled and finished they can be dyed to pattern with great certainty.

The fastest fancy shades are obtained by using Acid Alizarine Blueblack B or 3 B and Acid Alizarine Brown BB or B, as auxiliaries to which Mordant Yellow O, Alizarine Yellow GGW and Fast Mordant Blue B or R, also Alizarine Red 1 WS, Dianil Fast Red PH and Acid Alizarine Grey G may be used. These combinations yield shades which are fast to light and wearing and offer the best guarantee that during the manufacturing processes no bleeding into white or other light mixed shades takes place, even when heavily milled.

The dyebath is prepared for these combinations with the requisite dyestuffs, 10% Glauber's salt and 5% acetic acid 12° Tw., the wool is entered at 122—140° F, the temperature raised to the boil, and boiling continued for $^1/_2$ hour. To exhaust the bath, 1—2% sulphuric acid are then added, and boiled for another $^1/_2$ hour. After cooling the bath slightly (when dyeing in an apparatus) an addition is then made, according to the depth of shade required, of $^1/_4$—1% bichrome, and boiled again for $^1/_2$—1 hour.



1. Natural White.

2. Yellow Olive:
0,45% **Acid Alizarine Grey G**
0,3% **Acid Alizarine Red G**
1,2% **Mordant Yellow O**
10% Glauber's salt, 5% acetic acid; 2% sulphuric acid
1,5% bichrome.

3. Leaf Green:
1,2% **Patent Blue A**
1,25% **Mordant Yellow O**
10% Glauber's salt, 3% sulphuric acid
2% bichrome.

4. Cinnamon:
1,2% **Acid Alizarine Brown B**
1,75% **Mordant Yellow O**
0,15% **Alizarine Red 1 WS powder**
10% Glauber's salt, 3% sulphuric acid
2,5% bichrome.

5. Black:
1% oxalate of ammonia
18% **Acid Alizarine Black SET paste**
5% acetic acid, 2% sulphuric acid
3% bichrome.

6. Blue:
1,35% **Patent Blue A**
10% Glauber's salt, 4% sulphuric acid
1% bichrome.

7. Yellow:
2% **Cresotine Yellow G**
10% Glauber's salt, 3% acetic acid
2% bichrome.

8. Light Red:
2% **Dianil Red R**
15% Glauber's salt, 1% acetic acid.

A combination satisfying all demands as regards fastness to light, and which, although not always sufficient for heavy milling in respect of bleeding, is still in most cases satisfactory, is that of Acid Alizarine Grey G with Acid Alizarine Red G, and the addition of Mordant Yellow O and, if necessary, Patent Blue A and Acid Rosamine A. The wool is entered at about 122° F into the dyebath which has been prepared with 10% Glauber's salt, 5% acetic acid and the necessary quantity of dyestuffs, and is heated to the boil within $^1/_2$ hour; after boiling for $^1/_2$ hour, 2% sulphuric acid are added, and after further boiling for $^1/_2$ hour $^1/_4$—1% bichrome, in proportion to the amount of dyestuff used, and boiling continued for another $^1/_2$—1 hour.

1. Black
1% oxalate of ammonia
20% **Acid Alizarine Black SET paste**
5% acetic acid; 2% sulphuric acid
2.5% bichrome.

2. Grey
40% Black and 60% White.

3. Yellow Olive:
0,35% **Acid Alizarine Grey G**
0,15% **Dianil Brown 3GO**
2% **Cresotine Yellow G**
10% Glauber's salt, 5% acetic acid; 1% sulphuric acid.

4. Green.
3% **Dianil Yellow 3G**
1,6% **Patent Blue A**
10% Glauber's salt, 3% acetic acid; 3% sulphuric acid
1% bichrome

5. Nut Drab:
0,8% **Acid Alizarine Brown B**
0,35% **Alizarine Red 1 WS powder**
0,5% **Mordant Yellow O**
10% Glauber's salt, 3% sulphuric acid
1,5% bichrome.

6. White: Cotton.

The fancy shades so obtained are very clear, level and dyed through, provided the wool has been well scoured. They stand the aftertreatments exceedingly well, show a tendency to bleeding only when milled very heavily, but as their fastness to light and alkali is very satisfactory, they may be employed without hesitation wherever the demands as to fastness to milling are not excessive.

1. Cherry Brown:
0,4% **Mordant Yellow O**
2,75% **Acid Alizarine Brown B**
1,5% **Alizarine Red 1 WS powder**
0,4% **Acid Alizarine Black R**
10% Glauber's salt, 3% sulphuric acid
3,5% bichrome.

2. Coffee Brown:
2% **Acid Alizarine Brown B**
0,2% **Acid Alizarine Black R**
0,3% **Alizarine Red 1 WS powder**
1,4% **Mordant Yellow O**
10% Glauber's salt, 3% sulphuric acid
3% bichrome.

3. Blue Drab:
0,3% **Acid Alizarine Blueblack B**
0,08% **Patent Blue A**
0,025% **Mordant Yellow O**
10% Glauber's salt, 5% acetic acid; 2% sulphuric acid
1% bichrome.

4. Parrot Green:
2,75% **Mordant Yellow O**
0,18% **Patent Blue A**
10% Glauber's salt, 3% sulphuric acid
2% bichrome.

Brown.

Brown shades on loose wool intended for Melanges are very often produced with Alizarine Brown which is shaded off, according to the desired shades, with Mordant Yellow O or Acid Alizarine Yellow RC towards the yellow side, Alizarine Red 1 WS or 2 BW, or Alizarine Orange N towards the red side, Alizarine Blue A or DNW, or Ceruleine paste A and Acid Alizarine Black SE towards the darker side.

The wool is first mordanted with bichrome and tartar or, better still, with bichrome, sulphuric and lactic acid, and dyed in a weak acetic acid bath. Alizarine Brown, which is not easily fixed on the fibre often tends to bleed (viz. more than 3½—4 % powder or 10—12 % paste) in milling and to soil accompanying light shades. It is therefore necessary to observe some precautionary measures in its employment for Melanges, so as to avoid mishaps.

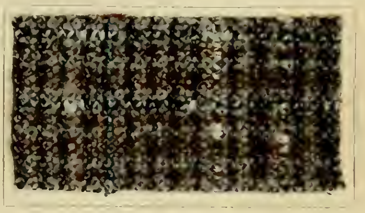
Brown (85 %):
4 % bichrome, 3 % tartar
15 % **Alizarine Brown paste**
0,25 % **Mordant Yellow O**
0,1 % **Acid Alizarine Black SE powder**
8 % acetic acid.

Silver (15 %):
Indigo dyed in the hydrosulphite vat with **Indigo MLB Vat I.**

The first essential for obtaining good results is that the wool is well scoured; it must not contain any residues of fatty and soapy matter; moreover, the material must be well mordanted especially in dark shades, for the production of which more than 15 % paste dyestuff are required (4 % bichrome and 3 % tartar or, instead of the latter, 1½ % sulphuric acid). When using lactic acid the wool should be mordanted with 2,5 % bichrome, 4 % lactic acid and 1 % sulphuric acid. Deep shades which require red are best obtained by adding to Alizarine Brown, some Alizarine Red and Alizarine Orange, and it is advisable to add ½—1 % fluoride of chrome after the completion of the dyeing operation, for a better fixation of the shade. The addition of a little copper vitriol also has a favourable effect upon the fastness to bleeding. In adopting these precautions no bleeding in milling will be experienced with Alizarine Brown, and as it satisfies all other demands as to fastness, good results will be obtained with it. As the only defect of the Alizarine Brown combinations must be regarded their want of fastness to carbonising with sulphuric acid, in all cases where the dyeing precedes the carbonising operation.

1. White: sulphur white.

2. Black:
1 % oxalate of ammonia
20 % **Acid Alizarine Black SET paste**
5 % acetic acid; 2 % sulphuric acid
3 % bichrome.



3. Brown:
1,2 % **Acid Alizarine Brown B**
1,75 % **Mordant Yellow O**
0,15 % **Alizarine Red 1 WS powder**
10 % Glauber's salt, 3 % sulphuric acid
2,5 % bichrome.

4. Blue Green (Effect):
1,75 % **Patent Blue A**
0,25 % **Acid Alizarine Grey G**
10 % Glaubers's salt, 2 % acetic acid; 3 % sulphuric acid
1 % bichrome.

Less to be recommended are brown shades obtained by a combination of Alizarine Orange N with Alizarine Blue or Ceruleine, though these are fast to carbonising. Their evenness often leaves much to be desired, and their fastness to light is inferior to that of the shades produced with Alizarine Brown as the principal dyestuff.

1 Brown

1,75 % **Acid Alizarine Brown BB**
0,8 % **Fast Mordant Blue B**
0,8 % **Acid Alizarine Yellow RC**
10 % Glauber's salt, 6 % acetic acid
2 % bichrome.

2 Pearl:

1 % **Fast Acid Blue R**
10 % Glauber's salt, 10 % acetic acid.

Still less fast to light is the combination of Alizarine Orange N or Alizarine Red with logwood and fustic upon a chrome mordant which soon turns red in wearing.

Absolutely fast Brown shades are obtained with Acid Alizarine Brown B, BB, RP or T as principal ingredients. For light shades the BB brand is used, shaded off, according to the character of the shade required, with Mordant Yellow O, Alizarine Red 1 WS, or Fast Mordant Blue B, R, or Acid Alizarine Blueblack 3B; deeper shades are produced with Acid Alizarine Brown B, BB, RP or T, which are shaded off with Acid Alizarine Black SE, SN or R, Acid Alizarine Yellow RC, and Alizarine Red 1 WS or Dianil Fast Red PH.

The shades of Acid Alizarine Brown come up fuller and more bloomy, if the dyebath is not kept too acid and only a small amount of bichrome is used for developing. The shades so obtained are, however, not quite so fast to milling and light as those obtained with more acid and more bichrome. On the other hand, the results will turn out somewhat lighter when an excess of acid and bichrome is used.

1. Olive:

2,5 % **Acid Alizarine Brown B**
0,5 % **Acid Alizarine Black R**
2 % **Mordant Yellow O**
0,1 % **Patent Blue A**
10 % Glauber's salt, 3 % sulphuric acid
3 % bichrome.

2. Black:

1 % oxalate of Ammonia
20 % **Acid Alizarine Black SET paste**
5 % acetic acid; 2 % sulphuric acid
2,5 % bichrome.

3. Green (Cotton):

upon tannin-tartar mordant:
1,25 % **Brilliant Green crystals extra**

4. Yellow (Cotton):

2,5 % **Aurophenine O**
2 % calc. soda, 40 % common salt

5. White: (Mercerised Cotton).

In order to produce shades which are as fast to bleeding as possible, the material is first dyed with 10 % Glauber's salt and 3 % sulphuric acid, and developed with as much bichrome as dyestuff. Where the depth of the shade requires larger quantities of Acid Alizarine Black SE, Acid Alizarine Yellow RC, or Dianil Fast Red PH, the liquid must first be boiled with 3 % acetic acid instead of 3 % sulphuric acid, and after raising the temperature to the boil slowly and boiling for 1/2 hour, 2 % sulphuric acid are added, boiling continued for another 1/2 hour and the shade developed as above stated.

The brown shades obtained with Acid Alizarine Brown and the above-named auxiliary dyestuffs stand milling very well and do not bleed into white or any accompanying light shades; they are fast to steaming and faster to light than those obtained upon previously mordanted material, and also faster to alkali. They possess, moreover, the advantage that they stand carbonising with sulphuric acid, are cheaper, and do not impair the quality of the wool to the same extent, and finally are more pliable in spinning.

1. Leaf Green:
1,2% **Patent Blue A**
1,25% **Mordant Yellow O**
10% Glauber's salt, 3% sulphuric acid
2% bichrome.

2. Coffee Brown:
2% **Acid Alizarine Brown B**
0,2% **Acid Alizarine Black R**
0,3% **Alizarine Red 1 WS powder**
1,4% **Mordant Yellow O**
10% Glauber's salt, 3% sulphuric acid
3% bichrome.

3. Dark Olive:
1,85% **Acid Alizarine Yellow RC**
0,375% **Alizarine Red 1 WS powder**
1,5% **Acid Alizarine Black R**
10% Glauber's salt, 5% acetic acid; 2% sulphuric acid
2% bichrome.

4. Huntsman's Green:
0,3% **Chromotrope F4B**
1% **Patent Blue A**
0,3% **Acid Alizarine Brown B**
2,75% **Mordant Yellow O**
10% Glauber's salt, 3% acetic acid; 2% sulphuric acid
3% bichrome.

Considering the sum total of their properties the shades obtained with Acid Alizarine Brown are therefore preferable to Alizarine shades.

1. Red Brown:
4,4% **Acid Alizarine Brown B**
1% **Alizarine Red 1 WS powder**
0,625% **Mordant Yellow O**
10% Glauber's salt, 3% sulphuric acid
3,5% bichrome.

2. Gold Olive:
0,75% **Acid Alizarine Grey G**
0,75% **Acid Alizarine Red G**
1,5% **Mordant Yellow O**
10% Glauber's salt, 5% acetic acid; 2% sulphuric acid
2% bichrome.

3. Leaf Green:
0,4% **Acid Alizarine Grey G**
2% **Patent Blue A**
2% **Cresotine Yellow G**
10% Glauber's salt, 5% acetic acid; 3% sulphuric acid
1,5% bichrome.

4. Porcelain:
0,024% **Fast Acid Blue R**
0,002% **Fast Acid Violet R**
10% sodium bisulphite crystals
4% sulphuric acid.

5. Black:
1% oxalate of ammonia
6% **Acid Alizarine Black SET powder**
3% acetic acid; 2% sulphuric acid
2,5% bichrome.

6. Sky Blue:
1,5% **Patent Blue A**
0,25% **Acid Violet 5BF**
10% Glauber's salt, 4% sulphuric acid
1% bichrome.

7. Finch Green:
1,6% **Patent Blue A**
3% **Dianil Yellow G**
10% Glauber's salt, 3% acetic acid; 3% sulphuric acid
1% bichrome.

Blue.

Fast Blue shades upon loose wool for Melanges are best and most safely produced with Indigo.

Since the processes of Indigo dyeing have been fully discussed in the previous chapters (vol. I, page 142 and vol. II page 19), we need only refer to these pages. The shades produced with Indigo are satisfactory in every respect, they are fast to light and wearing, and stand all the various operations of manufacture. Their fastness to bleeding, even of full shades next to white or other light shades, meets all demands of the trade, if dyed in a proper manner.

Austrian pike grey military cloth.

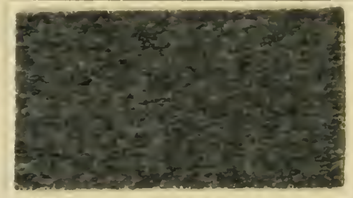
White (60%): Natural white.
Blue (40%): **Indigo** dyed in the hydrosulphite vat with **Indigo MLB Vat I.**

In order to obtain Indigo shades fast to bleeding upon loose wool intended for Melanges, the Indigo must be thoroughly fixed on the fibre. For if in milling the blue bleeds into the accompanying light shades, this can only be attributed to a mechanical staining of badly fixed Indigo, as the Indigo blue itself is insoluble in alkali. It is therefore essential to avoid all faults which are liable to retard the fixation in the vat. Wools intended for Indigo blued Melanges must therefore in the first place be well scoured, and be free from fatty or soap residues. If they have been carbonised before dyeing, great care has to be taken to neutralize them thoroughly, since wool containing acid absorbs the Indigo from the vat too rapidly, and then the results are not fast to rubbing nor to bleeding.

For dyeing, the vat must be in good condition: neither be too neutral nor contain any unreduced Indigo. Moreover the vats must not be too concentrated, and it is generally advisable to work in a weak vat and to give several dips, for the fewer the number of dips the more liable is the blue to rub.

Above all, however, it is essential, that in lifting the wool out of the vat, it is immediately and thoroughly squeezed in order to remove all superfluous vat liquor, as the Indigo so retained adheres superficially to the fibre, and is apt to stain the accompanying light or white shades during the subsequent spinning, weaving and milling processes. Wools which are not immediately and well squeezed after blueing, continually jeopardize the result of the Melanges.

Prussian Mantle cloth.



White (66%): Natural White.
Blue (34%): **Indigo** dyed in the hydrosulphite vat with **Indigo MLB Vat I.**

Worked with due regard to these precautions, indigo-dyed wool will always yield the best blue shade for Melanges, since no other blue dyestuff equals Indigo in point of fastness; moreover, as the material is dyed at a low temperature the wool retains its excellent pliability and firmness in spinning, a circumstance of great importance, especially for the production of army cloths.

Prussian Infantry Trousers Cloth.

Blue (33,3%):
3% bichrome, 2,5% tartar
14% **Alizarine Blue A paste 20%**
2×2,5% acetic acid.

Black (66,7%):
1% oxalate of ammonia
16% **Acid Alizarine Black SET paste**
5% acetic acid; 2% sulphuric acid
2,5% bichrome.

Next to Indigo Alizarine Blue must be taken into consideration. Of all blue mordant dyestuffs, it is the most important. The most current brands are: Alizarine Blue A and B, F; DN and DNW for light and medium blues, and Alizarine Blue 942 and Alizarine Darkblue S for darker shades. According to requirements the above-named brands can be combined with each other; they are likewise used in conjunction with Ceruleine B, BWR, BW conc. for greener shades, with Alizarine Red 1 WS for redder shades, and Alizarine Direct Blue B and Patent Blue A for particularly bright, lustrous shades.

For dark shades which require more than 15% paste dyestuff, the wool is first boiled with 4% bichrome and 3% tartar or, when lactic acid is employed, with 2,5% bichrome, 4% lactic acid and 1% sulphuric acid, and then dyed with the addition of some acetic acid. When properly fixed, the shades obtained with the above-named Alizarine Blue brands are very fast. They do not bleed when severely washed and milled, nor in finishing, and they are stable to carbonising with sulphuric acid. Neither depth nor brightness is impaired during the subsequent treatments, but the shade is liable to turn rather more greenish, so that keeping this slight change in mind, it is not difficult to dye exactly to pattern. Moreover by treating the blues subsequently with acetic acid the full bloom of the shades is restored.

Very frequently logwood is used together with Alizarine Blue for darkening purposes. Notwithstanding that the former leaves nothing to be desired in respect of fastness to bleeding, and reduces the cost of dyeing, it ought not to be employed for high class goods, or at all events only very sparingly, as it is neither fast to carbonising nor to light.

Fast Mordant Blue B and R are also most suitable for darkblue shades, when developed with bichrome. These colours are dyed with the addition of 10% Glauber's salt and 4% sulphuric acid, and developed, according to the depth of shade required, with the addition of $1^1/_2$—$2^1/_2$% bichrome. For shading the following are employed: Mordant Yellow O, Acid Alizarine Yellow RC, Alizarine Red 1 WS, Acid Alizarine Grenade R, Acid Alizarine Violet N, Acid Alizarine Grey G or Acid Alizarine Black SE and SN. The shades produced with Fast Mordant Blue are very fast to bleeding, and change in milling and steaming less than Alizarine Blue. They are equal to it as regards fastness to light, but have the advantage over Alizarine Blue that they are cheaper and preserve the quality of the wool to a greater extent.

Fast blue shades are also obtained with Fast Mordant Blue on previously mordanted wool, and they surpass in brilliancy those developed with chrome, so that Fast Mordant Blue B and R, dyed in the above manner, can be employed for lighter and brighter blues. Although the shades obtained upon previously mordanted material are not quite as fast to bleeding as those obtained by subsequent chroming or with Alizarine Blue, they suffice for purposes where no great depth is required. In order to improve the fastness to bleeding, so that accompanying white and light colours may remain unaffected, the shades obtained on previously mordanted material (especially darker ones), are finally fixed by adding $^1/_2$% bichrome or 1% fluoride of chrome. Being very soluble, Fast Mordant Blue is also very suitable for apparatus dyeing.

Blue (90%):
4% **Fast Mordant Blue B**
10% Glauber's salt, 5% acetic acid · 2% sulphuric acid
2% bichrome.
White (10%): sulphur white.

Another important dyestuff for blue shades is Alizarine Direct Blue B which is used especially for the production of more brilliant and lighter blue shades, owing to its pure shade, its excellent fastness to light and satisfactory fastness to wearing. As it is an essential point, when dyeing wool for multicoloured effects to produce fast shades which are as free from bleeding as possible, it is advisable to choose from among the various available methods of dyeing with Alizarine Direct Blue B the one which yields the fastest shades, viz., to dye in an acid bath and develop with bichrome. But even these shades do not, in respect of fastness to bleeding, occupy the same high rank as those dyed with Indigo, Alizarine Blue or Fast Mordant Blue. Nevertheless, Alizarine Direct Blue B can be recommended for the above purposes, in case the goods dyed with it are carefully treated during and after milling; for since Alizarine Direct Blue B bleeds with a bluish hue, it does not as a rule cause any trouble, especially as it is chiefly used for lighter shades. In many cases where only lighter milling has to be considered, the shades obtained in an acid bath and also those obtained on previously mordanted material are satisfactory; they are, in any case, distinguished for their superior fastness to wearing.

As a further representative of the series of chrome developing dyestuffs is to be mentioned Chromotrope DW, which possesses excellent fastness properties. It is dyed in a sulphuric acid bath and afterwards developed with chrome; in order to make the shades perfectly fast to milling and bleeding, bichrome and dyestuff are used in equal quantities, with an addition of 1–1½% sulphuric acid and 3–4% lactic acid. The shades so obtained do not appreciably change in milling and steaming, and are not inferior to Alizarine Blue shades in fastness to light and wearing.

1. Dark blue:
3% bichrome, 2,5% tartar
———
1% **Galleine conc.**
5% **Logwood Extract solid**
2% acetic acid.

2. Dark blue:
4% **Chromotrope FB**
0,8% **Patent Blue A**
0,42% **Fast Acid Violet R**
10% Glauber's salt, 3% acetic acid; 3% sulphuric acid
———
3% bichrome, 3% lactic acid, 1,5% sulphuric acid

3. Natural White.

4. Black:
1% oxalate of ammonia
6% **Acid Alizarine Black SET powder**
3% acetic acid; 2% sulphuric acid
———
2,5% bichrome.

5. Dark Red:
4% **Alizarine Red I WS powder**
1% **Scarlet B extra**
0,1% **Fast Acid Violet R**
10% Glauber's salt, 3% sulphuric acid
———
3% bichrome.

6. Yellow Olive:
0,35% **Acid Alizarine Grey G**
0,15% **Dianil Brown 3 GO**
2% **Cresotine Yellow G**
10% Glauber's salt, 5% acetic acid; 1% sulphuric acid
———
2% fluoride of chrome.

7. Nut Drab:
0,8% **Acid Alizarine Brown B**
0,35% **Alizarine Red I WS powder**
0,5% **Mordant Yellow O**
10% Glauber's salt, 3% sulphuric acid
———
1,5% bichrome.

8. Gold Olive:
0,75% **Acid Alizarine Grey G**
0,75% **Acid Alizarine Red G**
1,5% **Mordant Yellow O**
10% Glauber's salt, 5% acetic acid; 2% sulphuric acid
———
2% bichrome.

9. Leaf Green.
0,4% **Acid Alizarine Grey G**
2% **Patent Blue A**
2% **Cresotine Yellow G**
10% Glauber's salt, 5% acetic acid; 3% sulphuric acid
———
1,5% bichrome.

10. Orange:
10% alum, 2% oxalic acid, 2% tartar
———
2% **Alizarine Orange N powder**
1% **Dianil Yellow 3 G**
2% acetic acid.

Being easily soluble, Chromotrope DW is especially well adapted for apparatus dyeing, and the shades are very satisfactory as regards fastness to rubbing.

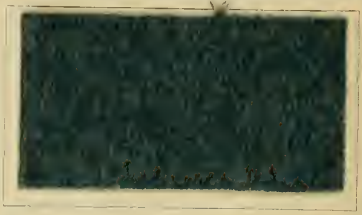
Chromotrope F 4 B and FB are also extensively used on loose wool, which is intended for Melanges. In that case, and in order to obtain the best possible fastness to bleeding, it is necessary to add, — as was stated in the case of Chromotrope DW — some lactic acid and sulphuric acid together with the bichrome to the developing bath. In sampling, regard must be had to the fact that in milling the shades produced with Chromotrope F4B and FB turn out somewhat redder; but they suffice for all demands in respect of fastness to wearing and light. Both have a tendency to bleed reddish when milled severely, and for that reason a certain caution must be exercised in using these dyestuffs for loose wool.

Another combination of very good value for blue upon loose wool is that of Logwood with Galleine upon a chrome mordant. But as this is much inferior as regards fastness to light to the combinations hitherto discussed, it should not be employed except for cheap goods or for wool intended for wefts for backing.

Green and Olive.

The fastest Green and olive shades upon loose wool for Buckskins and Melanges are produced by grounding the material with Indigo, and topping this Indigo ground with Alizarine Yellow GGW, Mordant Yellow O, or Acid Alizarine Yellow RC, with slight additions of Patent Blue A, Acid Alizarine Blueblack 3B, Acid Alizarine Grey G, Alizarine Red 1WS, Acid Alizarine Brown B, and developing with chrome. In as much as all green and olive shades permit of a fairly strong Indigo grounding, the shades so obtained are very fast in every respect.

Prussian grey green military cloth.



White (46%): Natural White.

Green (54%): **Indigo Ground,** topped with
0,26% **Alizarine Yellow GGW powder**
10% Glauber's salt, 3% acetic acid; 2% sulphuric acid
0,5% bichrome, 1% lactic acid.

With regard to the precautions to be observed for producing Indigo shades fast to bleeding, we refer to what was said at the beginning of the previous paragraph. But in topping the Indigo ground it must be remembered that the Indigo bottom is liable to be impaired by the bichrome in the presence of sulphuric acid. Sulphuric acid is therefore to be avoided in dyeing with the above-named shading-off dyestuffs; it is advisable to dye the latter in an acetic acid bath; and to chrome off with the addition of lactic acid.

If it is desirable to do without Indigo, Ceruleine is used as a direct mordant dyestuff for green and olive shades, the brands paste A and SW, as well as S powder yield dull olive shades, B, BW conc. and BWR powder brighter and bluer shades. The material is mordanted with bichrome and tartar, and shaded off in the dyebath with Alizarine Blue or Fast Mordant Blue towards the blue side, with Acid Alizarine Yellow RC, Alizarine Yellow GGW or Mordant Yellow O towards the yellow side, and with Alizarine Red 1 WS or Alizarine Brown towards the red to brown side. Very bright green shades are shaded off with Patent Blue A.

Olive (80%):
3% bichrome, 2,5% tartar
10% **Ceruleine A paste**
3% **Alizarine Brown paste**
0,5% **Mordant Yellow O**
8% acetic acid.

Silver (20%):
2% bichrome, 2% tartar
1% **Alizarine Blue A paste**
0,018% **Alizarine Red 1WS powder**
5% acetic acid.

Pronounced olive shades are mostly obtained, with a view to greater evenness, on previously mordanted material, by a combination of Alizarine Brown, Alizarine Blue and Mordant Yellow O. It is more advisable, however, to use chrome developing dyestuffs.

The fastest olive shades of this series are produced, on the one hand, with Acid Alizarine Brown BB and Mordant Yellow O or Acid Alizarine Yellow RC and, on the other hand, with one of the following blue or blackblue dyestuffs, named in the order of their degrees of fastness, viz.: Fast Mordant Blue B, R, Acid Alizarine Black SE, Acid Alizarine Blueblack 3B, Chromotrope DW, F4B, Acid Alizarine Grey G. Finally, green and olive shades eminently fast to bleeding can be produced with: Ceruleine BWR and Acid Alizarine Yellow RC

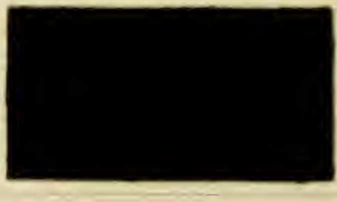
These combinations represent the best that can be produced in respect of fastness, and withstand even severe milling, and as the shades so produced change neither in milling nor steaming to any appreciable extent it is easy to dye to pattern.

For pronounced green shades the same good results are obtained with Fast Mordant Blue as ground colour, either dyed in an acid bath and developed with chrome, or dyed upon previously mordanted material, and then made fast to bleeding by adding small quantities of bichrome or fluoride of chrome, as described on page 50. Fast Mordant Blue is shaded off in both cases with Mordant Yellow O, Patent-Blue A, Alizarine Red 1WS or Acid Alizarine Brown B; the first-named two brands are used most largely for bright greens.

Bright green shades of very good fastness to wearing are obtained with Alizarine Direct Green G. According to the kind of milling to which the goods are subjected, it is used either in an acid bath or on previously mordanted material or finally dyed first in an acid bath and then developed with bichrome. The shades obtained by the latter method are extremely fast to bleeding, and only show a tendency to bleed into white when incautiously worked and very heavily milled; the first-named methods yield in most cases shades which can be considered sufficiently fast for lighter classes of goods.

The shades dyed with Alizarine Direct Green G are fast to rubbing, steaming and carbonising, satisfactorily fast to alkali and eminently fast to light, if necessary they are shaded with Alizarine Direct Blue B, Fast Mordant Blue B, or Patent Blue A towards the blue side, and with Mordant Yellow O, Alizarine Yellow GGW or any other yellow towards the yellow side, and thus yield very bright green shades, which are especially fast to wearing.

White: Natural White.
Green:
0.75 % **Chromotrope F4B**
1.25 % **Patent Blue A**
1 % **Mordant Yellow O**
10 % Glauber's salt, 3 % acetic acid; 3 % sulphuric acid
2,5 % bichrome.



Dark green.
1.5 % **Acid Alizarine Yellow RC**
1,5 % **Chromotrope F4B**
1,2 % **Acid Alizarine Black R**
0,25 % **Patent Blue A**
10 % Glauber's salt, 3 % acetic acid; 3 % sulphuric acid
3 % bichrome.

Porcelain:
0,12 % **Fast Acid Blue R**
10 % Glauber's salt, 3 % acetic acid; 2 % sulphuric acid

Violet.
3,5 % **Acid Alizarine Violet N**
0,5 % **Acid Violet 5BF**
20 % Glauber's salt, 4 % sulphuric acid
3 % bichrome.

Green:
2,5 % **Alizarine Direct Green G**
1 % **Mordant Yellow O**
1 % **Fast Mordant Blue B**
20 % Glauber's salt, 2 2,5 % acetic acid
2 % sulphuric acid
2,5 % bichrome.

1. **White:** Natural White

2. **Dark Green:**
1,5% **Acid Alizarine Yellow RC**
1,5% **Chromotrope F4B**
1,2% **Acid Alizarine Black R**
0,25% **Patent-Blue A**
10% Glauber's salt, 5% acetic acid; 3% sulphuric acid
3% bichrome.

3. **Dark Olive:**
1,75% **Acid Alizarine Yellow RC**
0,375% **Alizarine Red 1WS powder**
1,5% **Acid Alizarine Black R**
10% Glauber's salt, 5% acetic acid; 2% sulphuric acid
2% bichrome.

4. **Black:**
1% oxalate of ammonia
20% **Acid Alizarine Black SET paste**
5% acetic acid, 2% sulphuric acid
3% bichrome.

Finally green and olive shades are obtained with Chromotrope FB and DW, as a ground colour, which are then toned with Acid Alizarine Black R, Acid Alizarine Brown B, Mordant Yellow O, Acid Alizarine Yellow RC and Patent Blue A. These greens are sufficiently fast for most purposes, especially when they are not accompanied by other light colours and the goods are not subjected afterwards to very heavy milling. These shades are dyed in a sulphuric acid bath and developed with bichrome, lactic acid and sulphuric acid.

1. **Black:**
1% oxalate of ammonia
18% **Acid Alizarine Black SET paste**
3% acetic acid; 2% sulphuric acid
3% bichrome.

2. **Orange:**
1,4% **Aurophenine O**
0,04% **Dianil Red 4B**
10% Glauber's salt, 3% acetic acid.

3. **Blue green:**
1,75% **Patent Blue A**
0,25% **Acid Alizarine Grey G**
10% Glauber's salt, 2% acetic acid; 3% sulphuric acid
1% bichrome.

4. **Dark Green:**
0,8% **Chromotrope F4B**
0,32% **Patent Blue A**
0,8% **Acid Alizarine Brown B**
1,1% **Mordant Yellow O**
10% Glauber's salt, 3% sulphuric acid
3% bichrome.

5. **Light Green:**
1,6% **Patent Blue A**
1,2% **Dianil Yellow 3G**
10% Glauber's salt, 3% acetic acid; 2% sulphuric acid

6. **Black** Cotton):
6% **Thiogene Black M conc.** (running bath)
12% sodium sulphide cryst., 2% soda calc.
5% common salt.

7. **Yellow** (Cotton):
3% **Aurophenine O**
20% Glauber's salt, 2% soda calc.

The combinations of Acid Alizarine Grey G, Ceruleine BWR, Patent Blue A with Mordant Yellow O, or of Ceruleine BWR and Acid Alizarine Black R with Mordant Yellow O are also largely used on account of their satisfactory fastness and cheapness.

Copper, Claret and Currant Red.

If Mordant dyestuffs are to be used for these shades, it is advisable to employ Alizarine Orange N as foundation for copper shades upon a chrome mordant, whilst for claret and currant-red shades **Alizarine Red 2 BW** upon a chrome mordant is most suitable. These shades are shaded off with **Mordant Yellow O** towards the yellow side and with **Alizarine Blue A** towards the blue and dark sides; **Fast Mordant Blue B** or **R** may also be used instead of the latter. Bright currant red shades are obtained by combining **Alizarine Red 2BW** with **Galleine**.

The dark shades of this series, however, show a tendency to bleed in heavy milling; it is therefore necessary to observe the same precautions as in the case of Alizarine Brown (page 45): the wool must be well scoured, the mordants must be increased for fuller shades, substituting lactic or formic acid for tartar, and the colours must be fixed after dyeing by the addition of 1—2% fluoride of chrome or $^1/_2$—1% bichrome.

1. Brown:
4,4% **Acid Alizarine Brown B**
1% **Alizarine Red 1WS powder**
0,625% **Mordant Yellow O**
10% Glauber's salt, 3% sulphuric acid
3,5% bichrome.

2. White.

3. Black:
1% oxalate of ammonia
6% **Acid Alizarine Black SET powder**
3% acetic acid, 2% sulphuric acid
2,5% bichrome.

4. Dark Red:
4% **Alizarine Red 1WS powder**
1% **Scarlet B extra**
0,1% **Fast Acid Violet R**
10% Glauber's salt, 3% sulphuric acid
3% bichrome.

5. Yellow Olive:
0,35% **Acid Alizarine Grey G**
0,15% **Dianil Brown 3GO**
2% **Cresotine Yellow G**
10% Glauber's salt, 5% acetic acid; 1% sulphuric acid

6. Nut Drab:
0,8% **Acid Alizarine Brown B**
0,35% **Alizarine Red 1WS powder**
0,5% **Mordant Yellow O**
10% Glauber's salt, 3% sulphuric acid
1,5% bichrome.

7. Gold Olive:
0,75% **Acid Alizarine Grey G**
0,75% **Acid Alizarine Red G**
1,5% **Mordant Yellow O**
10% Glauber's salt, 5% acetic acid; 2% sulphuric acid
2% bichrome.

8. Leaf Green:
0,4% **Acid Alizarine Green G**
2% **Patent Blue A**
2% **Cresotine Yellow G**
10% Glauber's salt, 5% acetic acid; 3% sulphuric acid
1,5% bichrome.

9. Orange:
10% alum, 2% oxalic acid, 3% tartar
2% **Alizarine Orange N powder**
1% **Dianil Yellow 3G**
2% acetic acid.

10. White (Cotton).

The same shades, however when produced with **Chrome Developing Dyestuffs** are ever so much faster.

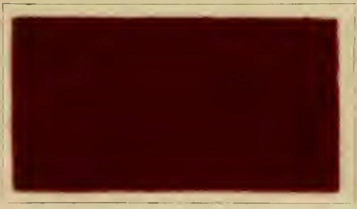
If **Acid Alizarine Brown BB** is combined with **Acid Alizarine Violet N** or **Acid Alizarine Grenade R** with the addition of **Mordant Yellow O**, fast claret and currant-red shades are obtained which vastly surpass those obtained by means of Alizarine dyestuffs upon previously mordanted material as regards fastness to bleeding; moreover, they change less in milling and steaming, and are faster to light. The foregoing combination is worked in one bath with the addition of sulphuric acid and developed with bichrome. It is not difficult to dye to pattern, and the quality of the material is better preserved than is the case when mordant dyestuffs are used.

Copper shades are produced by means of Acid Alizarine Brown BB, Mordant Yellow O and Acid Alizarine Red G or, instead of the latter, Alizarine Red 1WS may be employed. These combinations are in every respect as fast as the above-named claret and currant-red shades.

Red.

Red is seldom dyed on loose wool for Melanges.

If red shades are to be produced with Alizarine Red, the wool is mordanted with alum and tartar, as stated in vol I, page 134 and 135, and dyed with the addition of 5—7½% acetic acid and 1—2% tannin with Alizarine Red 2BW or, according to the required shade, with some other brand.



1. Red:
4,5% Acid Alizarine Red B
0,5% Fast Acid Violet R
10% Glauber s salt, 4% sulphuric acid
3% bichrome.
2. White: Natural White.

The shades so obtained change in milling a little towards the blue side, which fact must be reckoned with in matching. As they also tend to bleed, it is necessary to treat goods that contain Alizarine Red and accompanying light shades with caution in milling; above all, they should be washed and dried immediately after being milled.

Red shades produced with Acid Alizarine Red B and G, Acid Alizarine Grenade R and Mordant Yellow O — dyed in a sulphuric acid bath and developed with bichrome — are superior as regards fastness to bleeding. The same one-bath method can be followed in the case of Alizarine Red 1WS, which when shaded off with Mordant Yellow O, shows equally satisfactory fastness properties. However, they have the disadvantage in common with shades obtained with Alizarine Red upon Alum mordant, that they are not fast to acid and do not stand carbonising with sulphuric acid.

The fastest red shades are obtained with Dianil Fast Red PH. This colour is dyed in a weak acid bath with the addition of 10% Glauber's salt and 5% acetate of ammonia, subsequent addition of acetic acid, and developed with bichrome or fluoride of chrome. These shades, especially when developed with bichrome, stand heavy milling without bleeding into white, are excellently fast to light, and do not change in milling and steaming. They are also fast to carbonising, and the sum total of their fastness properties surpasses that of the other above-named combinations.

Black.

Black shades for Buckskins and Melanges are still very often dyed with logwood which not only satisfies all demands as to fastness to milling and bleeding, but is also inexpensive. The fastness to light of logwood black, however, leaves a great deal to be desired, and as nowadays a number of fast dyestuffs are at the disposal of the dyer, which are not very materially dearer than logwood and far superior as regards fastness to light, also highly satisfactory to milling, the use of logwood blacks is relegated more and more to the background.

Amongst our dyestuffs for black intended for Buckskins and Melanges, Acid Alizarine Black SE and SET which may be combined with each other or toned with Acid Alizarine Brown BB, Acid Alizarine Yellow RC and Fast Mordant Blue B or R are in the first place suitable. The application of Acid Alizarine Black SE has been fully described on page 16 and following page.

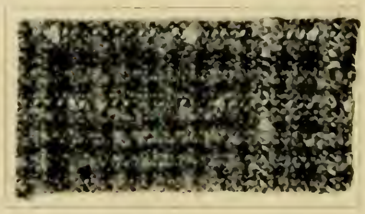
Acid Alizarine Black SE is eminently fast to light, milling, bleeding, steaming and carbonising; it is also in most cases sufficiently fast to being topped in an acid bath and yields wools of much better pliability than logwood blacks. On the other hand it almost equals the latter as regards purity and bloom.

Acid Alizarine Black SE can also be very well used upon previously mordanted material, in which case it can be combined with Alizarine Blue for blue black shades. It is dyed upon a chrome mordant which is best prepared with lactic or formic acid; in dyeing at first only half the quantity of acetic acid is added to the bath and the second half poured into it after boiling for half an hour; then after boiling for another half hour the shade is developed by the addition of ½—1 % bichrome.

1. White: Natural White.
2. Black:
    1 % oxalate of ammonia
    7 % **Acid Alizarine Black SET powder**
    5 % acetic acid, 2 % sulphuric acid
    2,5 % bichrome.

Acid Alizarine Black SN and SNT can be used for exactly the same purposes as the SE brands. Of equal fastness to light and milling to the latter and extremely soluble. Acid Alizarine Black SN and SNT are especially adapted for the purposes of apparatus dyeing.

1. White: Natural White.
2. Black:
    6 % **Acid Alizarine Black SNT**
    10 % Glauber's salt, 3 % acetic acid; 2 % sulphuric acid
    3 % bichrome.
3. Red:
    2 % **Dianil Red 4B**
    10 % Glauber's salt, 3 % acetic acid.
4. Green:
    1,6 % **Patent Blue A**
    1,2 % **Dianil Yellow 3G**
    10 % Glauber's salt, 3 % acetic acid; 2 % sulphuric acid.



The shades are very fast to rubbing; finally, brand SN is very fast to acid, so that its shades hardly bleed at all upon white wool when boiled in an acid bath, it may therefore be employed for most articles which are topped afterwards in an acid bath.

1. Black:
    1 % oxalate of ammonia
    20 % **Acid Alizarine Black SET paste**
    5 % acetic acid, 2 % sulphuric acid
    2,5 % bichrome.
2. Grey:
    40 % white + 60 % black.
3. Blue Green:
    1,32 % **Chromotrope S**
    2,33 % **Patent Blue A**
    0,38 % **Mordant Yellow O**
    0,25 % **Acid Violet 5 BF**
    10 % Glauber's salt, 3 % sulphuric acid
    2,5 % bichrome, 2,5 % lactic acid, 1,5 % sulphuric acid.
4. White: Cotton, mercerised.

To the above-named brands may be added those of Acid Alizarine Black R which, although not so fast to milling and bleeding as the SE and SN brands and, consequently, less used for shades for heavy cloth milling, are sufficiently fast for Buckskins, especially when care is taken that the goods do not lie long unwashed, particularly after milling. With sufficient precaution this colour does not bleed into white or other accompanying light shades, and the use of Acid Alizarine Black R and the other similar brands RH, T etc., is therefore permissible for dyeing loose wool for fancy goods.

These dyestuffs are distinguished for their equalising property, and a high degree of fastness to light, alkali and acid; they are dyed with the addition of Glauber's salt and sulphuric acid, and developed, according to depth of shade, with $1^{1}/_{2}$—$2^{1}/_{2}$ % bichrome. For shading-off Acid Alizarine Brown, Acid Alizarine Red, Acid Alizarine Grenade, Fast Mordant Blue Mordant Yellow, Alizarine Yellow may be used, also those shading-off acid dyestuffs which are fast to milling.

In conclusion we may mention Chrome Black, as suitable for the production of black shades upon loose wool intended for Melanges. This dyestuff satisfies most demands as regards fastness to bleeding, but in its general behaviour it is somewhat inferior to the Acid Alizarine Black brands, especially in regard to fastness to light, though it is better in that respect than logwood black. Chrome Black, which is put upon the market in the brands 2 G, B and T, is dyed with Glauber's salt and acetic acid, and developed by the addition of 2 % bichrome and 3 % blue stone.

1. Black: (80 %)
   1 % oxalate of ammonia
   18 % **Acid Alizarine Black SET paste**
   5 % acetic acid; 2 % sulphuric acid
   2,5 % bichrome.

2. Brown: (2 %)
   3 % bichrome, 2,5 % tartar
   0,47 % **Alizarine Brown paste**
   0,8 % **Alizarine Blue A paste**
   0,02 % **Alizarine Red 1 WS powder**
   5 % acetic acid.

3. White: (18 %) Natural White.

Bright Effect Shades.

Though not used in large quantities, the effect colours play a considerable part in wool dyeing for Buckskins and Melanges, particularly in the present fashion. Effect shades are introduced into pieces either as single threads, in which case they are mostly dyed in the yarn; — their production will be discussed in the chapter on yarn dyeing, — or twisted with threads of other colours. Not unfrequently they are also mixed as Melanges.

The chief effect colours are bright blue, green, silver and pearl, which last-named two were already treated at the beginning of this chapter; furthermore scarlet and yellow, more rarely olive, copper and violet.

Very bright blue shades are dyed with Alkali Blue; in order to obtain the best possible fastness to milling, this colour is treated with per-chloride of tin and alum. The blue shades obtained with Victoria Blue or the combination of Patent Blue A with Acid Violet 5BF are faster to milling, and still more so the shades produced by the same combination upon an Alizarine Direct Blue B ground.

Green blue to green shades are obtained with Patent Blue A and Mordant Yellow O, dyed in a sulphuric acid bath and developed with 1—2 % bichrome. Faster shades are produced by using Alizarine Direct Green G which can be shaded off with both the above-named dyestuffs. For redder blue and dark blue shades Patent Blue A is combined with Milling Blue RR extra or Acid Violet 5BF, and darkened with Acid Alizarine Grey G or Fast Mordant Blue B. Dyeing is effected with acetic acid, and the shade developed with 2—3% fluoride of chrome.

Alizarine Yellow GGW, Mordant Yellow O, Milling Yellow O, or Dianil Yellow 3G, Cresotine Yellow G, Oxydianil Yellow O or G are used for yellow shades, for red shades Milling Scarlet 4R conc., by mixing which with yellow, orange shades are obtained. Dyeing is commenced with 10% Glauber's salt and 5% acetic acid, some more acid added, and the shade finally fastened with fluoride of chrome.

Black (85%):
1% oxalate of ammonia
6% **Acid Alizarine Black SET powder**
5% acetic acid; 1% sulphuric acid
2,5% bichrome.

Green (15%):
1% **Patent Blue A**
0 75% **Mordant Yellow O**
10% Glauber's salt; 4% sulphuric acid
1,5% bichrome.

Olive shades are produced with Mordant Yellow O, Acid Alizarine Grey G, Alizarine Direct Green G, Patent Blue A and Acid Alizarine Red G; brown and copper shades with Mordant Yellow O, Acid Alizarine Red G, Acid Alizarine Brown BB and Dianil Brown 3GO; they are produced by dyeing with 10% Glauber's salt and 5% acetic acid, 2% sulphuric acid being added after boiling for ½ hour, and then developed with 1—2% bichrome.

1. Black:
1% oxalate of ammonia
6% **Acid Alizarine Black SET powder**
3% acetic acid; 2% sulphuric acid
2,5% bichrome.

2. White: Wool.

3. White: Mercerised Cotton.

4. Pearl:
0,35% **Fast Acid Blue R**
0,85% **Acid Alizarine Grey G**
0,05% **Fast Acid Violet R**
10% Glauber's salt, 5% acetic acid; 1% sulphuric acid

5. Yellow Olive:
0,35% **Acid Alizarine Grey G**
0,15% **Dianil Brown 3GO**
2% **Cresotine Yellow G**
10% Glauber's salt, 5% acetic acid; 1% sulphuric acid

6. Sky Blue:
1,5% **Patent Blue A**
0,25% **Acid Violet 5BF**
10% Glauber's salt, 4% sulphuric acid
1% bichrome.

7. Finch Green:
1,6% **Patent Blue A**
3% **Dianil Yellow 3G**
10% Glauber's salt, 3% acetic acid; 3% sulphuric acid
1% bichrome.

8. Drab Olive:
0,2% **Acid Alizarine Grey G**
0,2% **Alizarine Red 1 WS powder**
0,65% **Mordant Yellow O**
10% Glauber's salt, 5% acetic acid; 2% sulphuric acid
0,5% bichrome.

Violet shades are dyed with Milling Blue 2R extra and Fast Acid Violet R in a sulphuric acid bath, and fixed by an aftertreatment with 2% fluoride of chrome.

Goods with effect threads are generally not fast to bleeding, and must therefore be carefully treated in milling, especially when they contain white or light accompanying shades. They should not be left unrinsed after milling, but washed and dried without delay. Goods containing effect threads dyed with Alkali Blue are sometimes treated with diluted acid, in order to revive the blue shade after milling or carbonising and neutralizing.

2. The Dyeing of Shoddy.

The employment of shoddy, i. e, of wool obtained by tearing up and recarding used woollen goods, and of the waste from weaving spinning and manufacturing, is increasing steadily, thanks to the great perfection of the machinery and also to the endeavour to cheapen the manufacture.

According to its composition and origin, shoddy wool is used under various designations, such as shoddy, mungo, thybet, waste etc., and in various ways. It is spun and manufactured, partly by itself, partly worked together with unused wool as backing weft for material which otherwise contains pure wool, and partly mixed and spun together with new wool or with cotton.

Shoddy reaches the dyer either in the form 1. of rags, ends, waste etc., or 2. of yarn, or 3. of manufactured goods. Shoddy yarn and piece dyeing will be discussed in later chapters; at present we shall deal only with the dyeing of shoddy in the loose state.

According to the purpose for which the shoddy is intended, whether it is to be used up for milled goods or for goods that do not require milling, the demands upon fastness vary, and therefore we have to distinguish between two kinds of shoddy dyeing. Before, however, entering in detail upon the methods of dyeing, we will discuss the treatment of shoddy before dyeing, i. e, its "stripping".

The Treatment of Shoddy before Dyeing.

Shoddy — as was already said — consists of waste and remnants of woollen goods of various kinds and colours, derived from dress materials, carpets, stockings, shawls, yarns, from ends and waste pertaining to the manufacture of woollen goods, etc.

The task for the dyer, in working up this material of ever varying composition, is to produce beautiful, bright and fast shades, evenly and of uniform depth, so as to obtain results, which are as similar as possible to pure wool. Although, in general, the methods of dyeing, the dyestuffs and dyeing appliances used closely resemble those employed for dyeing pure wool, still the varying composition of the material involves many difficulties, for the dyer is often expected to produce not only bright shades but also very light effects upon a ground which is often multicoloured and mostly dark.

The dyeing of shoddy is materially facilitated if the rags or waste is sorted beforehand according to quality into finer and coarser kinds, into light, medium and dark shades, and finally into red, blue, green, black etc. colours. These can then be used for dyeing according to depth and shade required.

The second operation is the carbonising of the rags, its object being to destroy the cotton warp or weft, effect threads, cotton sewing threads, remnants of cotton linings etc. contained in them. If cotton is present in any considerable quantity, so that the goods would sustain a serious loss of weight by carbonising, this operation is mostly dispensed with, and the rags are then used up manufactured as half-wool rags. The methods of dyeing to be adopted in such cases will be dealt with in the volume on "half-wool dyeing".

The carbonising of shoddy is usually effected in specially constructed rotating carbonising drums by means of gaseous hydrochloric acid or sulphuric acid, as described on page 11.

After carbonising, and in order to remove the burnt vegetable matter, the goods are treated on the willowing machine, after which the acid is neutralised, so as not to interfere with the subsequent dyeing process.

Thereupon the shoddy is stripped, if necessary, i. e., the original dyestuffs on it are removed as far as possible. Stripping has the twofold object of removing, on the one hand, any loose dyestuff from the shoddy, so that no troubles or mishaps through want of fastness to bleeding and milling may occur in its subsequent manipulations, and, on the other hand, to deprive dark coloured shoddy as much as possible of its colour in order to make it more suitable for lighter and bright shades. Stripping is therefore mostly omitted as unnecessary if the shoddy is to be dyed again to dark colours.

For stripping purposes several products are available, the most usual of which are sulphuric acid, soda, hydrosulphite and bichrome.

Stripping by means of sulphuric acid is chiefly used for such rags as contain a considerable amount of mordant and wood dyestuffs, and which are to be dyed later with acid dyestuffs in an acid bath, especially for blue, in which case the yellow ground caused through stripping with bichrome would have a disturbing effect. The rags are boiled in a cistern with 10% sulphuric acid, the colour lakes are thereby destroyed, and all natural colouring matters and most of the Alizarine dyestuffs are stripped. After stripping the rags are slightly rinsed, or sometimes taken straight into the dyebath, in which latter case the addition of acid is avoided.

Stripping by means of soda is chiefly used for rags which are obtained from ladies clothes and hosiery; these are dyed in most cases with simple acid dyestuffs which, with a few exceptions, do not withstand a severe treatment with soda; they must be removed in order to obtain fast shades, especially to milling. Stripping with soda is done as follows: the goods are treated with 10% soda for about 1/2 hour at a temperature of 104—122° F; they are then well rinsed, and are now ready for dyeing.

Bichrome in the presence of sulphuric acid is most frequently used for stripping and generally yields the best results. The majority of artificial and natural dyestuffs do not resist this strong oxidizing reaction or are transformed by it into faster shades, so that they stand milling well, and are not liable to bleed any more. These stripping baths injure the quality of the wool comparatively little, and the boiling with bichrome and sulphuric acid has, at the same time, the effect of mordanting the wool, so that it can at once be dyed with mordant dyestuffs. For this very reason this method is so largely employed and almost exclusively resorted to for shoddy, which is to be dyed fast to milling with mordant dyestuffs.

Stripping with bichrome is effected by boiling the rags, according to the depth of shade and the original dyestuffs on them, with 3—6% bichrome and 5—12% sulphuric acid. The time of boiling varies according to the nature and depth of the dyestuffs present on the rags, and the amount of chrome used. In weak chrome baths the goods are boiled for 1/2 -1 hour, in strong baths 1/4—1/2 hour. Stripping is promoted by the addition of 3—6% oxalic acid. The goods must be well rinsed after stripping, in order to prevent the mordant dyestuffs from working on too rapidly through the presence of too much acid.

Stripping by means of nitric acid was formerly more often used than nowadays: the rags were treated at the boil with 10—25% nitric acid, to which sometimes a further addition of muriatic or sulphuric acid was made. This treatment, though destructive to the dyestuffs, often turns them into yellow coloured products, so that the stripped material is then suitable only for brown, olive, green etc. shades. Moreover, the wool fibre itself is also affected and altered by this process and consequently the method is now seldom resorted to.

Stripping by means of hydrosulphite has recently met with much favour, since our stable preparations Hydrosulphite NF, NF conc., AZ and conc. powder have become readily available.

Hydrosulphite NF is worked in the following manner: The goods are first treated, in a wooden cistern, in a lukewarm bath containing 5% Hydrosulphite NF or 2 1/2% Hydrosulphite NF conc., and 1 1/2% formic acid. The temperature is then slowly raised to the boil, and the goods worked for 1/2—3/4 hour. Instead of formic acid double the amount of bisulphite

72° Tw. or acetic acid may be used to equal advantage. If the rags are very dark or the colours not easily destroyed, some more Hydrosulphite NF and correspondingly more formic acid, bisulphite or acetic acid must be used.

In stripping with Hydrosulphite AZ, 3% of the latter are made into a paste with water and then added to the bath; then 1½% formic acid or 3% acetic acid or bisulphite or else 2% sulphuric acid are added, and finally the goods worked in the same manner as described above. Of Hydrosulphite conc. powder, 2—3% are dissolved in water, and the same quantities of acid added.

The process of stripping with Hydrosulphite is very serviceable, since the majority of acid wool dyestuffs are entirely destroyed by hydrosulphite, so that it is possible to obtain very light results even from dark rags. Moreover the material remains practically unimpaired and the greatest possible preservation of the wool is effected.

The dyer will have to choose from the above-named stripping processes the one which seems to him the most suitable according to the material to be treated, its colour and the shade required, and it will be advisable for him to assure himself first by a trial, which method will afford the best result and which proportions of concentration are to be adopted. For, considering that all stripping processes impair the wool fibre in a certain degree, it is not possible to follow one method by another, as the wool fibre would thereby be too much affected.

The Dyeing of Shoddy for Milled Goods.

The stripping of shoddy is followed by dyeing. When it is intended to produce dark shades, stripping can be dispensed with, unless it is carried out in order to destroy some loose colours which would make themselves unpleasantly noticeable by bleeding in the later processes of manufacture, particularly in milling. These faults are frequently attributed to the dyestuffs used in dyeing, whereas they are, in reality, due to the original dyestuffs on the goods. For that reason and for safety's sake it is advisable always to strip shoddy which is intended for milling.

It goes without saying that the shoddy must be free from fatty or soapy matter. If that is not the case, or cleansing has been omitted before carbonising or stripping, the material must be treated before dyeing in a tepid bath with ammonia or soda, and then well washed.

The shades which must be considered for shoddy intended for milled goods are the same as are chiefly current in fast wool dyeing, viz., in the first place black, then blue, brown and drab; also, according to fashion, to a varying degree olive and green, and lastly copper and currant red. Consequently the dyestuffs to be considered are for the most part the same or similar as for wool.

One of the principal requirements for dyeing shoddy is the thorough dyeing through of the rags etc., as, otherwise, the material would, in the further processes of manufacture after tearing and carding, appear grey and mottled.

For that reason the Chrome Developing Dyestuffs are especially suitable for the production of fast milling shades upon shoddy; as further advantages are to be mentioned: the one bath method dyeing whereby the material is least impaired; their good fixation and their cheapness. In addition it must be borne in mind that almost all the chrome developing dyestuffs fix themselves upon the chrome deposited on the fibre in stripping with bichrome and acid, so that only small quantities of bichrome are required for the final development.

Next to the chrome developing dyestuffs the faster of the acid dyestuffs are also much employed, especially those that are rendered remarkably fast to milling by an aftertreatment with chromium salts, as e. g. Patent Blue A. The Alizarine dyestuffs are more seldom used in dyeing shoddy fast to milling, for considering the low of value the material they are far too expensive and their fixation is not an easy one. On account of its cheapness the combination of Alizarine Red with logwood and fustic is sometimes still resorted to, but only for brown shades.

Black.

Black shades are very largely dyed upon shoddy. While they were formerly mostly obtained with logwood, after stripping with bichrome and acid, — which is however particularly fugitive to light upon this mordant and on previously carbonised material — artificial dyestuffs have nowadays almost entirely superseded logwood for black shades.

1. Black:
   7% **Acid Atizarine Black SNT**
   10% Glaubers's salt, 3% acetic acid; 2% sulphuric acid
   3% bichrome.
2. Black (Cotton):
   15% **Thiogene Black B2R liquid** (old bath);
   5% sodium sulphide cryst., 2% soda calc.; 10% common salt.
3. Green (Effect):
   2,5% **Patent Blue A**
   1% **Mordant Yellow O**
   10% Glauber's salt, 4% sulphuric acid
   2% bichrome.

Of these must be mentioned, in the first place, the Acid Alizarine Black brands which, as regards fastness to milling, are almost equal to logwood black, and satisfy all demands in that respect; they are however far superior to logwood blacks as regards their fastness to light. Of these dyestuffs the brands SE and SET are less frequently used, because they are somewhat sensitive to metal salts that may be present in the shoddy. When there is no fear of this they are dyed in an acetic acid bath with the addition of 1% oxalate of ammonia, sulphuric acid being then added for their complete exhaustion, and bichrome for development.

Acid Alizarine Black R and the similar brands 3B and 3B extra, also SN and SNT are more frequently used; the first named brands yield good black shades even on very dark material, owing to the purity of their shade. They are dyed with the addition of 10% Glauber's salt and 8% acetic acid or 2% sulphuric acid, some more acid being added in order to exhaust the baths; they are developed as usual.

The fact that Acid Alizarine Black can be dyed upon previously mordanted material, makes it possible to fix the colour perfectly with ½—1% bichrome on shoddy which has been stripped with bichrome and sulphuric acid.

Our Chrome Black which fixes itself equally and uniformly is in the very highest degree suitable for dyeing shoddy, even on the most diverse material. It dyes the rags through very well, and has great covering capacity. Contrary to most other artificial blacks Chrome Black B, 2G and T also possess the valuable property of not being affected by the tannic acids and metal salts contained in shoddies.

Chrome Black B yields a very pure bloomy black; with it a neutral black is obtained even upon a brownish ground, whereas other dyestuffs mostly require the addition of embellishing dyestuffs, in order to obtain an acceptable black. Chrome Black 2G, yielding a greener shade, is especially suitable for a red ground, whereas Chrome Black T is more adapted for jet black shades, particularly upon lighter material.

1. Black.

5% **Chrome Black T**
3% sulphuric acid

2% bichrome, 2,5% copper vitriol.

2. Black (Cotton):

15% **Thiogene Black B2R liquid** (cold bath)
5% sodium sulphide, 2% soda; 10% common salt.

3. Red (Effect)

2,75% **Acid Alizarine Red G**
0,4% **Acid Alizarine Brown BB**
10% Glauber's salt, 4% sulphuric acid

2% bichrome.

4. Green (Effect, Cotton)

12% **Thiogene Green GL extra**
24% sodium sulphide, 5% soda; 50% common salt.

The fastness of Chrome Black to milling suffices for the most exacting demands, as even the severest milling does not alter the shade, nor causes bleeding into white wool or cotton. Its fastness to rubbing and light surpasses by far that of logwood, and the cost of production is scarcely higher than that of logwood black.

The method of dyeing is very simple: The goods are dyed in a weak sulphuric acid bath at the boil for ¾—1 hour, after which the shade is developed by adding 1½—2% bichrome and 1½—3% copper sulphate, and boiling is continued for another ½ hour. The bath can be used again for further lots. It is unnecessary to neutralise carbonised materials before dyeing; the amount of acid is either reduced or omitted in that case, as too much acid impedes the development of the Chrome Black.

Blue.

For the different blue shades we can recommend Patent Blue A, Milling Blue 2R extra and Acid Violet 5BF, either alone or in combination with one another. The method of dyeing with these dyestuffs is as follows:

The goods are dyed in a sulphuric acid bath; for shoddy stripped with acid no further acid is required. The rags are entered at 104—122° F and the temperature raised to the boil; if after boiling for ½ hour the liquid is not exhausted, some more acid and 10% chrome alum are added and boiling continued for ½ hour. The latter ingredient may also be added to the bath at the beginning.

In dyeing shoddy stripped with bichrome and sulphuric acid, no addition of chrome alum need be made. Chrome alum materially increases the fastness to milling, especially in regard to bleeding, and assists likewise in fixing any remnants of the original dyestuff that may still be left in the rags. Very little or no acid is required for rags which have been stripped with acid; a better fixation and penetration is thereby effected.

The blue shades obtained with the above-named dyestuffs are very bright and therefore of especial value for dyeing shoddy; they withstand milling and washing exceedingly well, and can be used in the manufacturing process next to white or light accompanying colours.

Less bright blue shades are best dyed on a ground of Fast Mordant Blue R and B. As these brands can be dyed and yield fast lakes on a chrome mordant, they are particularly suitable for dyeing shoddy stripped with bichrome and sulphuric acid. Owing to the readiness of Fast Mordant Blue to form lakes, care must be taken that the rags and, for that matter, the bath are not too acid at first. The goods must therefore be well rinsed after being stripped, or the dyebath is prepared with a little ammonia at the beginning, the rags treated in this for some time and then the dyestuff solution and sulphuric acid added.

Dark blue shades are obtained, especially upon lighter ground, by a combination (according to the shade of the raw material) of **Patent Blue A**, **Acid Violet 5BF** or **Milling Blue 2R extra** with **Chrome Black B**, in which case the shade is developed with 1—2 % bichrome.

1. Black:
1 % oxalate of ammonia
10 % **Acid Alizarine Black SET paste**
5 % acetic acid; 2 % sulphuric acid
3 % bichrome.

2. Black (Cotton):
15 % **Thiogene Black B2R liquid** (old bath)
5 % sodium sulphide, 3 % soda, 10 % common salt.

3. Blue Grey:
1,5 % **Acid Alizarine Grey G**
0,25 % **Fast Acid Violet R**
0,5 % **Patent Blue A**
10 % Glauber's salt, 3 % sulphuric acid
1 % bichrome.

4. Grey:
0,75 % **Acid Alizarine Grey G**
0,1 % **Acid Alizarine Red G**
10 % Glauber's salt, 5 % acetic acid, 2,5 % sulphuric acid.
0,5 % bichrome.

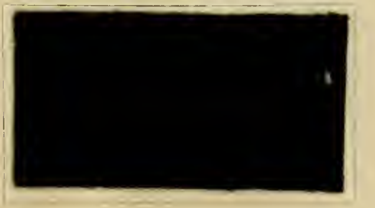
5. Green (Effect, Cotton):
10 % **Thiogene Green GL extra** (new bath)
20 % sodium sulphide, 5 % soda, 50 % common salt.

Green and Olive.

Green shades upon shoddy are most conveniently obtained by a combination of **Patent Blue A** with **Mordant Yellow O**. For that purpose the shoddy is boiled with the above-named dyestuffs in an acid bath, and the shade developed by adding 2—3 % bichrome and boiling for 3/4—1 hour.

Darker green and olive shades are produced with **Acid Alizarine Black R** and **SN**, **Chromotrope FB**, **F4B**, **Fast Mordant Blue R** and **B**, **Ceruleine BWR**, **Patent Blue A**, **Mordant Yellow O** and **Acid Alizarine Brown BB**. The goods are dyed in an acid bath, and in using Ceruleine only little acid is added at first, in order to ensure a slow and even dyeing. The shade is then fixed by the addition of 2—3 % bichrome and boiling for 3/4 hours.

The green and olive shades produced by the above combinations are very bright and fast to light and milling.



0,27 % **Chromotrope F4B**
0,7 % **Acid Alizarine Brown BB**
0,1 % **Patent Blue A**
2 % **Mordant Yellow O**
10 % Glauber's salt, 4 % sulphuric acid
2 % bichrome.

1. Dark Olive:
1 % Acid Alizarine Brown BB
1,75 % Mordant Yellow O
0,75 % Acid Alizarine Black R
0,5 % Ceruleine BWR powder
10 % Glauber's salt, 4 % sulphuric acid
3 % bichrome.

2. Olive:
1 % Acid Alizarine Brown B
1 % Mordant Yellow O
0,75 % Acid Alizarine Black R
10 % Glauber's salt, 4 % sulphuric acid
2,5 % bichrome.

3. Green (Effect):
0,5 % Mordant Yellow O
0,4 % Acid Alizarine Grey G
0,45 % Patent Blue A
10 % Glauber's salt, 5 % acetic acid; 2 % sulphuric acid
0,5 % bichrome.

4. Red (Effect):
4 % Acid Alizarine Red G
0,15 % Fast Acid Violet R
10 % Glauber's salt, 4 % sulphuric acid
3 % bichrome.

Brown.

For dyeing fast brown shades upon shoddy intended for milling the Acid Alizarine Brown brands are the most important products. These dye slowly and evenly upon shoddy — stripped either with bichrome and acid or with sulphuric acid alone — and yield, when developed with chrome, brown shades which are very fast to milling and light, and which are superior to those dyed with Alizarine Brown, (sometimes used for the same purpose) as regards better fixation, greater fastness to rubbing and lower price. Acid Alizarine Brown moreover, dyes thick rags and even seams well through, so that the shades obtained therewith are much more solid and brighter after tearing than those obtained with Alizarine Brown which does not penetrate the material well.

1. Black:
5,75 % Chrome Black B
5 % acetic acid, 2 % sulphuric acid
2 % bichrome, 2,5 % copper vitriol.

2. Olive Brown:
2,5 % Acid Alizarine Brown B
1,25 % Mordant Yellow O
0,6 % Acid Alizarine Black R
10 % Glauber's salt, 3 % sulphuric acid
2,5 % bichrome.

3. Drab:
1,25 % Acid Alizarine Grey G
0,7 % Acid Alizarine Red G
0,35 % Mordant Yellow O
10 % Glauber's salt, 5 % acetic acid; 2 % sulphuric acid
2 % bichrome.

4. Green (Effect):
2 % Acid Alizarine Grey G
0,9 % Patent Blue A
10 % Glauber's salt, 5 % acetic acid; 3 % sulphuric acid,
1,5 % bichrome.

5. Red (Effect):
2,5 % Acid Alizarine Red B
1 % Acid Alizarine Red G
10 % Glauber's salt, 4 % sulphuric acid
2,5 % bichrome.

Acid Alizarine Brown shades are dyed in a sulphuric acid bath, however, the baths must not be made too acid; they are developed by the addition of bichrome. The quantity of the latter must also be kept low, especially when dyeing material which has been stripped with bichrome and sulphuric acid, as otherwise the dyeing power of the Alizarine Brown dyestuffs is not brought out properly.

Acid Alizarine Browns are shaded off with Mordant Yellow O towards the yellow side, with Acid Alizarine Red G and B towards the red side, with Ceruleine BWR, Acid Alizarine Violet N, Acid Alizarine Black R and Patent Blue A towards the green and dark sides.

The brown shades produced with Acid Alizarine Brown satisfy, as regards fastness, all demands made upon shoddy which is to be manufactured into milling goods.

1. Black:
1% oxalate of ammonia
20% **Acid Alizarine Black SET paste**
5% acetic acid; 2% sulphuric acid
3% bichrome.

2. Light Olive:
1,5% **Acid Alizarine Brown BB**
2% **Mordant Yellow O**
0,5% **Ceruleine BWR powder**
10% Glauber's salt, 3% sulphuric acid
2,5% bichrome.

3. Olive:
2,5% **Acid Alizarine Brown BB**
2% **Mordant Yellow O**
1,5% **Ceruleine BWR powder**
10% Glauber's salt, 4% sulphuric acid
3% bichrome.

4. Red (Effect):
2% **Milling Scarlet 4R conc.**
1% **Milling Yellow O**
10% Glaubers's salt, 5% acetic acid; 2% sulphuric acid
2% fluoride of chrome.

5. Green (Effect):
1% **Acid Alizarine Grey G**
0,4% **Patent Blue A**
0,1% **Mordant Yellow O**
10% Glauber's salt, 5% acetic acid;
2,5% sulphuric acid
2% bichrome.

Red, Claret and Copper.

Fast red, claret and copper shades upon shoddy are less frequently in demand than the colours hitherto discussed.

For red shades the Acid Alizarine Red brands are suitable. They are dyed in a sulphuric acid bath, and developed in the usual manner with 2—3% bichrome. For shading off Mordant Yellow O, Acid Alizarine Grenade R, Acid Alizarine Violet N and the Fast Acid Violet brands are used.

Claret and copper shades are obtained with the same dyestuffs, and shaded off with Milling Blue 2R extra, Acid Alizarine Brown etc.

The shades so obtained are in every respect satisfactory as regards fastness to light and milling, at the same time the process of dyeing is safer and cheaper than that of using Alizarine Red, Alizarine Orange and Alizarine Brown.

Very pure red shades of extreme fastness to milling and light can be obtained upon shoddy by means of Dianil Fast Red PH, but care must be taken in this case that the material is not at all, or only slightly acid. It is therefore usual first to neutralize carbonised or acid stripped shoddy; to prepare the dyebath with 20% Glauber's salt and 5% acetate of ammonia, and not to heat it too quickly to the boil. In order to exhaust the colour 2—4% acetic acid are added and the shade fixed after boiling for ½—1 hour with 2% bichrome or 4% fluoride of chrome. For bright blue-red to pink shades, Rosazeine O or Fast Acid Violet R may be used as topping colours.

Grey and Drab.

Grey and drab shades are best combined with Acid Alizarine Grey G, Mordant Yellow O and Acid Alizarine Red G. The material must not be too strongly acid, and light shades are dyed with the addition of 3% acetic acid, and a further addition of 2% sulphuric acid, whereas darker shades can be dyed direct with sulphuric acid; according to depth required, the shades are developed with ½—2% bichrome.

In order to obtain even results, it is essential, as already remarked, especially with light shades, that the dyestuffs be not too quickly absorbed by the material, in consequence of its too strongly acid reaction or that of the dye liquid.

0,4% **Acid Alizarine Brown BB**
0,35% **Chromotrope F4B**
0,08% **Patent Blue A**
1,5% **Mordant Yellow O**
10% Glauber's salt, 3% sulphuric acid
2,5% bichrome.

The grey and drab shades obtained with the above-named dyestuffs are very fast to bleeding and sufficiently so to heavy milling. Also in respect of light and wearing the fastness of these combinations is satisfactory.

1. Green Drab:
   1,25% **Acid Alizarine Grey G**
   0,4% **Acid Alizarine Red G**
   0,15% **Mordant Yellow O**
   10% Glauber's salt, 5% acetic acid; 2% sulphuric acid
   1,5% bichrome.

2. Blue Grey:
   1% **Acid Alizarine Grey G**
   0,05% **Acid Alizarine Red G**
   0,025% **Mordant Yellow O**
   10% Glauber's salt, 3% acetic acid; 3% sulphuric acid
   1% bichrome.

3. Mignonette.
   1,15% **Acid Alizarine Grey G**
   0,25% **Acid Alizarine Red G**
   0,1% **Mordant Yellow O**
   10% Glauber's salt, 5% acetic acid; 2% sulphuric acid
   1,5% bichrome.

4. Blue Green (Effect, Cotton):
   9% **Thiogene Green BL extra** (new bath)
   15% sodium sulphide cryst., 5% soda calc.; 40% common salt.

5. Yellow Green (Effect, Cotton):
   10% **Thiogene Green GL extra** } (new bath)
   5% **Thiogene Yellow GG** }
   20% sodium sulphide cryst., 5% soda calc.; 40% common salt.

6. Yellow (Effect, Cotton):
   5% **Thiogene Yellow GG** (new bath)
   5% sodium sulphide cryst., 5% soda calc., 40% common salt.

The Dyeing of shoddy intended for goods which are not to be milled.

Shoddy is frequently used for articles, such as cheap hosiery, carpets or curtains, upon which smaller demands are made as regards fastness. Especially the fastness to milling of these goods need only be very slight. Also the other fastness properties — fastness to light, alkali, washing — have to be subordinated to brightness of shade and cheapness. For that reason, all shoddy intended for these purposes, is dyed in the simplest and cheapest manner possible.

The preparation of the shoddy material is the same as previously described for shoddy intended to stand milling. For dyeing, the ordinary acid colours and in many cases also the basic dyestuffs are used.

Of acid dyestuffs the most used are, according to the shades desired: Fast Yellow O, Naphthol Yellow S, the various Orange brands, Scarlet, Victoria Rubine, Naphthol Red, Fast Red, Acid Green, Patent Blue V, Naphthaline Green, Indigo Substitute, Naphthaline Blue, Fast Blue, Soluble Blue, Acid Violet, Amidonaphthol Black etc.

It is superfluous to enter into details with regard to the application of these dyestuffs for different shades. The dyeing is carried out in the usual manner, with due consideration of the ground colour of the material. The goods are dyed in an acid bath. Material which has been previously stripped by means of bichrome and acids or with sulphuric acid or, as is best for light shades, with Hydrosulphite AZ, can be dyed direct without neutralisation, if dyestuffs are employed which equalize readily. However, when using dyestuffs which equalise with difficulty, such as Fast Red and soluble Blues, it is advisable to neutralise the material before dyeing in case it contains acid, also to add the acid very gradually, commencing at a low temperature, and making further additions later in order to exhaust the dyebath. Dyestuffs equalising with still greater difficulty, e. g., Fast Blue, are likewise dyed on neutralised material with the addition of Glauber's salt and acetic acid, and sulphuric acid is added only for exhausting the bath.

Basic dyestuffs which are employed on account of their bright shades when no special demands as to fastness, particularly fastness to light are made upon the goods are also much used: Magenta, New Magenta, Cerise, Maroon, Brilliant Green, Malachite Green, Vesuvine, Methyl Violet, Victoria Blue and Rosazeine. In using basic dyestuffs the shoddy must first be neutralised, as otherwise these colours are not easily taken up by the material. The dyebath is prepared with 2—5% acetic acid and the requisite quantities of the well dissolved dyestuffs; the goods are entered at a medium temperature, the latter gradually raised to the boil and the dyeing operation finished by boiling for $^1/_2$—1 hour. The two last-named dyestuffs, Victoria Blue and Rosazeine, may also be used in combination with Acid dyestuffs in a sulphuric acid bath.

In conclusion, we may briefly allude to the dyeing of the waste products which originate from the finishing operations and are still sometimes used. The coarser waste from sheering is milled on to the back of cheap cloths, the finer dust-like waste is used in the manufacture of wall papers for melange effects. Consequently the demands as to fastness vary, for in the former case colours fast to milling, which are produced with mordant and chrome developing dyestuffs, are required; whereas in the latter case principally black and, very bright shades are wanted, for the production of which acid dyestuffs are usually employed.

On the methods of dyeing these two kinds of waste we need not enlarge any further; they are carried out in the same manner as for loose wool and shoddy, so that it is only necessary to refer to the preceding descriptions.

3. The Dyeing of loose Cotton.

The wool dyer is often called upon to dye loose cotton which is intended to be mixed with wool or shoddy in order to produce cheaper goods. Cheap cloths for gentlemen's or ladies' wear very often contain nowadays more or less cotton on the front or back, and thicker materials, such as overcoatings, mantle cloths etc, are frequently made with cotton backs.

For such purposes the cotton is dyed by itself, and afterwards mixed and spun together with the dyed wool. The demands made upon the cotton in these cases, are: to match the shade of the wool as exactly as possible; also satisfactory fastness to light and wearing alkali and perspiration, and milling.

These demands are satisfied by a few direct dyestuffs which are fast to milling and light, and principally by the Thiogene dyestuffs; since the introduction of the latter which are in every respect fast, cotton is undoubtedly used to a much greater extent than formerly in the manufacture of Buckskins and Melanges.

Although the dyeing of cotton has been the subject of minute discussion in a former volume dedicated to that particular branch of dyeing, a brief description of the dyeing of loose cotton with sulphur dyestuffs, as far as is necessary for understanding their application, may be given. We proceed to review the principal colours.

The generally adopted method of dyeing with Thiogene dyestuffs — which of course belong to the series of Sulphur Colours — is to employ them with the addition of sodium sulphide, soda and Glauber's salt or common salt. Soda lye is less frequently used as a substitute for soda; glucose is added to the baths, in dyeing with Thiogene Blue, and serves for producing greater evenness of shade; Turkey red oil assists in wetting the material thoroughly, and improves the equalisation. The sodium sulphide serves as a solvent of the dyestuffs; since an excess of it is usually not harmful, too small an addition should be avoided, so as to ensure a thorough solution of the dyestuff. The addition of soda aids, as a rule, the dissolving action of the sodium sulphide. The addition of common or Glauber's salt to the dyebath serves the same purpose as in dyeing cotton and half wool with direct dyeing dyestuffs, i. e., it drives the dyestuff upon the fibre. Therefore, the same observations hold good: in employing them, the amount of common or Glauber's salt to be taken should be larger in proportion to the greater depth of shade required and the quantity of dye liquid used, i. e., the more of the latter there is in proportion to the material to be dyed. Consequently, for lighter and fancy shades the amount of salt should be proportionately less than for dark shades, and in dyeing on mechanical apparatus smaller amounts are used than in dyeing in an open cistern.

For dyeing with Thiogene dyestuffs it is best to use wooden or iron or lead lined vessels and apparatus. Copper or brass apparatus, cisterns and pipes are unsuitable, owing to the strong reaction of sodium sulphide upon these metals.

The dyestuff solution is prepared by mixing the weighed dyestuff in a wooden tub with some hot water, then adding the requisite quantity of sodium sulphide, and boiling the whole whilst stirring it continuously and adding more water. The solution is then poured into the dyebath, to which soda and salt are then added.

In dyeing in an open cistern, the dry material is entered into the bath at the boil and the cotton well worked through during the first $^{1}/_{4}$ hour. It is then left in the simmering bath for another $^{3}/_{4}$ hr., lifted or squeezed out, and the superfluous liquid allowed to run back into the bath. The material is then hydroextracted in an iron or lead lined hydroextractor, allowed to lie, especially for black, for a few hours longer or overnight, thoroughly washed and dried. In dyeing in a mechanical apparatus the cotton is washed in the apparatus immediately after dyeing.

The addition of soda and salt has to be gauged in such a manner that the density of the liquid stands at 9—10½° Tw.; for lighter shades the amount of salt is reduced accordingly. When using a mechanical apparatus on which the operation is carried on for an hour at the boil, the dyebath is most conveniently prepared, instead of with common salt, with the more slowly exhausted and purer Glauber's salt, the amount of which is at the same time diminished; lighter shades are dyed entirely without the addition of salt.

As a rule no aftertreatment is necessary for the shades produced with Thiogene dyestuffs. Only for the Thiogene Blue brands the simple operation of subsequent oxidation by storage in a warm and humid place is to be recommended. To that end the cotton merely squeezed out after leaving the dyebath is left in skeps or in heaps for several hours or overnight, and then washed. This process renders the shade fuller and redder. In general, it is advisable to dye wool which is to be worked together with cotton, rather brighter than sample, as the cotton shades, compared to those of the wool, are duller in appearance.

Black.

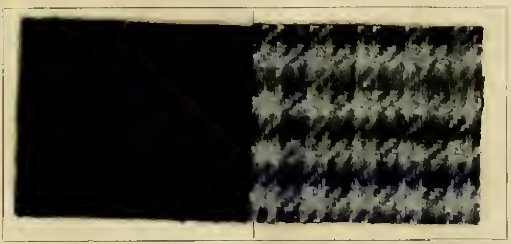
Of the black sulphur dyestuffs it is mainly the concentrated and the liquid Thiogene Blacks that are to be considered for dyeing loose cotton.

The chief brands of the former are Thiogene Black MM conc., which yields a black of greenish hue, 2B conc. giving a blueblack, and B2R conc. a black of reddish hue. The corresponding liquid brands are M liquid, 2B liquid and B2R liquid.

In dyeing in the cistern, where the proportion of goods to liquid is 1:20, the following quantities of conc. dyestuffs and other ingredients are used for a medium black:

	% dyestuff	% sodium sulphide cryst.	% soda calc.	% common salt
1. bath	10	30	10	50
2. bath	8	16	3	10
3. bath and following	6	12	2	2

In dyeing on mechanical apparatus, the dye liquid is prepared with the same quantities, only the amount of common salt is reduced to $^1/_3$—$^1/_5$ of the figures above, according to the volume of the liquid. As the baths are not exhausted, it is best to work in old baths.



Right side:

Black:

1% oxalate of ammonia
18% **Acid Alizarine Black SE paste**
0,5% **Acid Alizarine Brown BB**
5% acetic acid, 2% sulphuric acid
2,5% bichrome.

Back:

Black:

8% **Thiogene Black MM conc.** (old bath)

Violet:

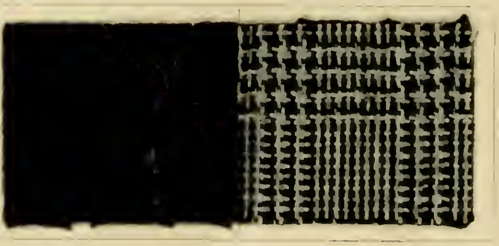
1,3% **Acid Violet 5BF**
10% Glauber's salt, 4% sulphuric acid
10% chrome alum.

The concentrated Thiogene Black brands are readily soluble and, therefore, very suitable for apparatus dyeing; they equalise well and yield full, deep black shades.

The liquid Thiogene Black brands, are more convenient to handle. They represent a 50% solution of the leuco dyestuffs of the concentrated brands, to which they stand, therefore, in a similar relation as our Indigo vat I to Indigo MLB. The use of the liquid brands is naturally facilitated by their liquid form, seeing that the troublesome weighing and dissolving operations can be dispensed with and the great inconvenience caused by the colour dust flying about is thus avoided. The liquid Thiogene Blacks can be added directly to the baths prepared with the other ingredients. Owing to the reduced form of the dyestuff it is necessary to use for an equal depth of shade 1/3 of the amount of sodium sulphide required for the concentrated brands.

The baths are therefore got ready in the following manner for Thiogene Black M liquid, 2B liquid and B2R liquid:

	% dyestuff	% sodium sulphide cryst.	% soda calc.	% common salt
1. bath	22	10	10	50
2. bath	16	5,5	3	10
3. bath and following	13	4,25	2	3



Right side:

Black:

1% oxalate of ammonia
18% **Acid Alizarine Black SE paste**
0.5% **Acid Alizarine Brown BB**
5% acetic acid, 2% sulphuric acid
2,5% bichrome.

Back:

Black:

8% **Thiogene Black MR conc.** (old bath)

Red:

6% **Primuline O,** diazotised and developed with β-naphthol.

The liquid brands are otherwise worked in the same way as the concentrated Thiogene Black brands. All of them yield fast shades which satisfy all demands respecting fastness to

Wool (60%)

1% oxalate of ammonia
6% **Acid Alizarine Black SET powder**
5% acetic acid, 1% sulphuric acid
2,5% bichrome

Cotton (40%)

13% **Thiogene Black M liquid** (old bath).

Right side:

98% Blue (Camel hair) + 2% White (Mohair)

Blue:

4% **Fast Mordant Blue B**
0,4% **Acid Violet 5BF**
10% Glauber's salt, 3% sulphuric acid
2% bichrome.

Back:

1. Blue Green:

1% **Patent Blue A**
0,5% **Acid Alizarine Grey G**
0,04% **Mordant Yellow O**
10% Glauber's salt, 3% acetic acid; 2% sulphuric acid
1% bichrome.

2. Blue:

1,25% **Chromotrope F4B**
0,4% **Acid Violet 5BF**
0,2% **Patent Blue A**
10% Glauber's salt, 3% sulphuric acid
1,5% bichrome, 1% lactic acid, 1% sulphuric acid.

3. Black (Wool):

1% oxalate of ammonia
16% **Acid Alizarine Black SE paste**
0,4% **Acid Alizarine Brown BB**
5% acetic acid, 2% sulphuric acid
2,5% bichrome.

4. Black (Cotton):

16% **Thiogene Black B2R liquid** (old bath).

light, rubbing and alkali, neither in milling do they give cause for complaints as to bleeding next to white wool or cotton, or loss of shade. They may, therefore, be confidently used for wool and cotton in the manufacture of Buckskins and Melanges:

Blue.

Dark Blue shades upon cotton which is to be mixed with wool for Buckskins, are best obtained with Thiogene Dark Blue BL and BTL, the former yielding a somewhat bright, the latter a rather greener and darker navy blue. The dyebaths are prepared in the following manner:

	% dyestuff	% sodium sulphide cryst.	% soda calc.	% Glauber's salt cryst.	% soda lye 36% Tw.
1. bath	9	13	6	35	3
2. bath	7,5	7,5	2	10	—
3. bath and following	7	7	1,5	5	—

Both brands equal the Thiogene Black brands in respect of fastness, but require a subsequent oxidation in order to bring out the full beauty of the shade. For that purpose

Wool (60%):

3,75% **Fast Mordant Blue B**
0,25% **Fast Acid Violet R**
0,15% **Patent Blue A**
10% Glauber's salt, 4% sulphuric acid
2,5% bichrome.

Cotton (40%):

6% **Thiogene Blue 2R**
8% **Thiogene Dark Blue BTL.**

the dyed goods, after being lifted and squeezed out, are left to themselves in heaps or skeps for several hours, before being washed.

Brighter and more bloomy blue shades are obtained by the combination of Thiogene Dark Blue BL or BTL with Thiogene Blue B, R or RR. The baths are prepared in the same manner (as above stated) and the dyed goods also subjected to subsequent oxidation by being kept in a damp and warm state, before they are washed.

Green and Olive.

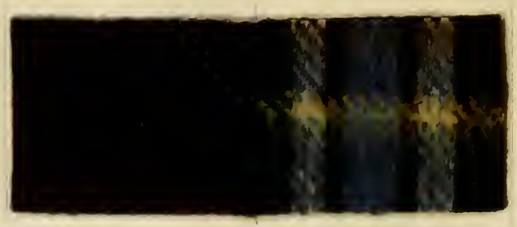
For green shades upon loose cotton Thiogene Green BL extra and GL extra, which yield clear, bright shades are used. They are easily soluble, and suitable for apparatus dyeing. The necessary additions are shown in the following table:

Wool:
1. Olive
0,3% **Acid Alizarine Brown BB**
0,225% **Mordant Yellow O**
0,33% **Fast Mordant Blue B**
10% Glauber's salt, 3% acetic acid; 2% sulphuric acid
1,5% bichrome.

2. Pearl.
0,25% **Fast Acid Blue R**
10% Glauber's salt, 5% acetic acid.

Cotton:
3,8% **Thiogene Brown GC**
1,8% **Thiogene Black MM conc.**

	% dyestuff	% sodium sulphide cryst.	% soda calc.	% common salt
1. bath	10	10	5	30
2. bath	9	9	3	10
3. bath and following	7,5	7,5	1,5	5



Right side
[illegible] **Acid Alizarine Brown B**
[illegible] **Mordant Yellow O**
[illegible] **Acid Alizarine Grey G**
10% Glauber's salt, 3% acetic acid, 2% sulphuric acid
2% bichrome.

Back:
Wool: 1. Blue Green:
0,5% **Acid Alizarine Grey G**
1% **Patent Blue A**
0,06% **Mordant Yellow O**
10% Glauber's salt, 3% sulphuric acid
1% bichrome.

Wool: 2. Silver:
0,25% **Acid Alizarine Grey G**
0,2% **Fast Acid Blue R**
10% Glauber's salt, 3% acetic acid.

Wool: 3. Brown:
3% **Acid Alizarine Brown B**
1,5% **Mordant Yellow O**
10% Glauber's salt, 3% sulphuric acid
2,5% bichrome.

Cotton: 4. Blue Green:
12,5% **Thiogene Green BL extra**

Cotton: 5. Silver:
1% **Thiogene Cyanine O.**

The material is dyed for an hour at the boil, then lifted, squeezed or hydroextracted and finally washed.

Yellower shades are obtained by a combination of the above-mentioned dyestuffs with Thiogene Yellow GG.

Olive shades are obtained by a combination of Thiogene Green with Thiogene Brown GC or Thiogene Orange (without aftertreatment). Thiogene Blue B and Thiogene Yellow G also yield olive shades; in that case, however, a subsequent oxidation by keeping the goods in a damp and warm state is necessary.

The dark drab-olive shades which are at present much in demand are best produced with Thiogene Black MM conc. or M liquid, and Thiogene Brown GC, to which may be added smaller quantities of Thiogene Brown R, according to shade required.

All these combinations are in every respect satisfactorily fast.

Brown and Drab.

For brown shades there are a number of yellowish to darkbrown dyestuffs available: Thiogene Brown GC, GR, G2R, R and S, all of which, either alone or mixed with one another and shaded off with Thiogene Black, admit of the production of any desired shade.

Right side:

Drab (90%):
1,5% **Chromogene I**
0,08% **Patent Blue A**
0,06% **Alizarine Yellow GGW powder**
0,06% **Acid Alizarine Grey G**
10% Glauber's salt, 4% sulphuric acid
2% bichrome, 0,75% sulphuric acid.

White (10%): Natural white.

Back:

Drab:
7% **Thiogene Brown GC**
2% **Thiogene Black NA**

Green:
5% **Thiogene Green GL extra**

The composition of the dyebath can be gathered from the following table:

	% dyestuff	% sodium sulphide cryst.	% soda calc.	% common salt
1. bath	10	10	5	40
2. bath	8	8	2	10
3. bath and following	6	6	2	3

Wool:

[illegible] Acid Alizarine Grenade R
[illegible] Mordant Yellow O
[illegible] Fast Mordant Blue B
[illegible] Glauber's salt, 3 % sulphuric acid
0,75 % bichromate.

Cotton:

0,45 % Thiogene Brown R
0,1 % Thiogene Black M liquid
0,9 % Thiogene Brown GC.

The material is dyed for 1 hour at the boil and washed directly afterwards.

Drab shades are produced by mixtures of Thiogene Black M liquid, Thiogene Brown GC and Thiogene Brown R.

Both the darkbrown shades and also the lighter shades, for which a smaller addition of salt is required in order to ensure evenness of shade and which, as a rule, do not necessitate the keeping of old baths, are very fast to rubbing and milling, nor do they bleed in milling. In regard to fastness to light they also satisfy the demands made upon them.

4. The Finishing of Wool-dyed Goods.

The dyed loose wool, after being washed and dried, is first spun and then woven, either alone if intended for plain-coloured goods, or mixed with white or coloured wool or cotton if intended for Melanges. The fabric so produced is then scoured, i. e., freed from the spinning oil by treatment in a diluted warm solution of soda, or in a soap solution containing soda in case the yarn has been lubricated with vegetable oil; it is then milled and after this carbonised, unless this process had already taken place before, or is wholly omitted i. e. for light shades, lower class goods, or such as contain cotton. Very often, however, it is the practice to reverse the order and to carbonise and then mill the cloths in the "rough" state after scouring and washing; this is especially the case if the goods are to undergo a very severe milling process.

Carbonising is followed by the finishing operations; these comprise raising, drying, shearing, pressing and, if required, steaming (decatising), all of which are intended to improve the marketable condition of the goods.

If, in the following pages, we attempt to discuss these operations briefly we do so in the same sense and with the same intention as we treated the operations prior to dyeing, touching upon the aftertreatments only in so far as they influence the quality of the goods in respect of fastness or character of the shades.

Scouring.

In order to restore the original suppleness of the wool fibre, which has been deprived of most of its natural fats before dyeing so as to ensure a better fixation of the dyestuffs, but whereby it has been rendered somewhat brittle, and also in order to enhance its spinning capacity, it is treated before spinning with oils, such as olive oil, and fats. This prevents as much as possible the breaking or tearing of the single wool fibres during spinning, so that loss and waste are minimised and the spinning of finer and smoother grades of yarns is made possible.

Endeavours are made to obtain a similar result by sizing the warps before weaving, which consists in steeping and treating them with solutions or emulsions of animal or vegetable glue, starch, fats and oils of various kinds, for the purpose of glueing the single wool fibres together and of imparting greater strength and a smoother surface to the warp threads, so that, on the one hand, they offer less resistance to the shuttles in weaving and, on the other hand, they are as little as possible roughened and damaged by the shuttles themselves and by their continual passing through the reeds and gearings of the looms.

The rough piece coming out of the loom has, then, before being treated any further, to be freed from the spinning oils and fats, or from the size of the warps.

This purifying process, called scouring, consists in treating the cloth generally with a warm or, more rarely, with a cold soda solution to which soap is sometimes added, and which has a saponifying and, consequently, solvent reaction upon the fats and oils present. Unless the spinning oils were removed beforehand, the milling process would be retarded, since they counteract the necessary friction between the wool fibres, and neutralize the efficacy of the milling agents. An especially unfavourable effect would be produced by the presence of fatty substances in acid milling, as the acids liberate fatty acids, and it would then be absolutely impossible to remove the latter from the goods, which are thus rendered impervious. It is, therefore, necessary always to carry out the scouring process with great care.

For scouring it is convenient to use soda solutions of 3—6° Tw. with or without the addition of soap, and to pass the rough cloth through washing machines either at full width or in rope form at about 104° F. for about an hour until the saponification of all the fatty ingredients has taken place. These are then removed by thorough rinsing with water. The washing is so regulated that at first only very little water is allowed to run into the machines, and then gradually more and more is added, so as to prevent the soap from caking the cloth, i. e., from forming lime soap which, when once formed, cannot be removed easily.

It is a "sine qua non" for the success of the scouring operation that the fatty substances used can be perfectly saponified with soda, and that they do not contain any non-saponifiable ingredients. The addition of mineral oils to the spinning fats, made now and then with the object of cheapening them, does not fulfil the above condition, and must be considered as mischievous; for wool goods which have been scoured with these oils will present the greatest difficulties and show great disadvantages in finishing and such ought never to be used in well-conducted dyeworks.

The colours should stand the scouring process well; the shades should not alter at all, or only very slightly, in the alkaline treatment, nor suffer loss of intensity to any appreciable degree. Especially with Melanges and figured goods the demands in that respect are very strict, for, on the one hand, the risk of bleeding into white or light accompanying shades is to be reckoned with and, on the other hand, should any of the shades become lighter or change, the total effect of the Melange is altered, so that it does not come up equal to pattern.

The dyestuffs and their combinations named in the different chapters satisfy the demands made upon them in the scouring process, provided it is carried out in a normal manner.

Milling.

The object of milling is to transform the loose fabric coming out of the loom as "rough cloth" into the denser and more durable material in which the weave and combination of threads is not apparent or less so than in the rough cloth.

The milling process is based on the property of wool fibres to intertwine at the ordinary or, better still, at a moderately warm temperature under pressure and in presence of sufficient liquid, i. e., to felt. This felting process is fostered by the presence of alkaline agents, such as soap, soap lyes, soda, ammonia, putrid urine etc., or by acids, such as sulphuric, acetic or formic acid. Accordingly, we have to distinguish between alkaline and acid milling, the former being the older and most employed process.

In both cases the single wool fibres unite and felt most intimately in milling, and, according to the kind of weave of the cloth, the threads disappear gradually or almost totally, whilst at the same time the fabric is being considerably reduced in length and width, i. e., it "shrinks". On the other hand its strength is greatly enhanced through the close union of the single wool fibres.

Milling is carried out in machines of special and varied construction. In the roller milling machines the goods pass continuously through either one or two pairs of rollers, with the addition of soap and soda solutions; in other machines, the so-called stocks, which are also sometimes used for scouring, they are kneeded by means of contrivances in the shape of mallets. The quantity of soap and soda and the duration of the milling vary in accordance with the character of the goods and the effect which is to be attained.

The action of the milling process upon the colours is in most cases even more energetic than that of scouring, since besides the alkaline reaction of the milling lyes, a great amount of friction is brought to bear upon the goods, which generates heat, especially when the process is carried on — as is the case in heavy milling — for 8—10 hours.

If, as is unfortunately frequently done in order to reduce the time, the milling lyes are made too strongly alkaline, and if want of attention causes the pieces to run too dry and, consequently, too hot in milling, even the fastest shades are liable to be injured; under normal conditions, however, all the dyestuffs named in the last two chapters stand the milling process very well. If, notwithstanding, mishaps do occur, they must be attributed to other causes. Should the wool have been badly scoured or still contain some wool grease or lime soap, the colour lake is detached in milling along with them from the fibre. In that case the shades lose in intensity and turn lighter and greyer. But the real cause of these defects must be looked for in the wool scouring, instead of being laid at the door of the dyer, as is often done.

For a number of years acid milling has been introduced instead of alkaline milling, e. g., especially in the manufacture of hats and felt. For that purpose sulphuric acid of 3° Tw., or a mixture of sulphuric acid with acetic acid or formic acid is employed, and the milling process carried out in the same manner as in alkaline milling.

The chief advantage of acid milling lies in the better preservation of the natural strength and gloss of the wool, as also in greater cheapness and a shorter time of milling. Perfect scouring, thorough rinsing after scouring, and very good cleansing of the wool initially are necessary for the success of acid milling.

A larger number of the dyestuffs mentioned in the previous chapters is more sensitive to the action of acid milling than to that of alkaline milling. Notably Alizarine Red, Alizarine Orange, Alizarine Brown and Galleine, i. e. the mordant dyestuffs whose lake formation takes place in a weak acid bath, but whose lakes are either loosened or partly destroyed by treatment with stronger acids. When therefore these dyestuffs are employed, acid milling must be carried out with caution.

On the other hand, the chrome developing dyestuffs offer a much better resistance to acid milling, which is easily explained by the fact that their lakes are developed in a strongly acid bath; consequently, where acid milling is to be used, it is advisable to employ chrome developing dyestuffs; Indigo also stands acid milling very well, and by it is rendered brighter and redder.

Carbonising.

Unless the carbonising of the goods has already been effected in the loose wool before dyeing, it becomes the next operation after milling, it is especially necessary for dark shades which show up the undyed vegetable substances more strongly than light shades.

For goods which are to be raised but slightly or not at all, it is, however, more advantageous to carbonise the cloth in the "rough" state, i. e., before milling, because in such cases the carbonised vegetable portions can be much more easily removed in consequence of the friction during milling, and this moreover closes up the small gaps caused by the removal of the carbonised vegetable substances. In this case the goods are scoured before carbonising and then washed absolutely clean, in order to remove the spinning fat. Otherwise fatty acids are liberated from the fatty ingredients during the subsequent carbonising operation, and are then so firmly fixed upon the goods under the influence of the heat in the carbonising chambers, that it is impossible to remove them. It is important that the goods be most carefully neutralized before milling.

The carbonising of wool-dyed piece goods closely follows, as a rule, the lines described on page 12 for carbonising loose wool, and is effected either by means of sulphuric acid of 4—6° Tw. or of aluminium chloride 9—12° Tw.

The goods are impregnated with the acid in wooden vessels running in rope form over a winch about 20—30 minutes, till a complete and even impregnation has been effected. They are then very carefully and evenly hydroextracted, and brought into the carbonising machine. Light goods are sometimes impregnated by passing them at full width continuously through roller cisterns with squeezing appliances, and thence direct into the carbonising machine. The latter consists usually of 2 separate chambers, the first of which, in the case of carbonisation with sulphuric acid, is heated to about 122—140° F., the second to 158—176° F. The pieces pass at full width through both chambers, and the speed is regulated according to the thickness of the goods.

In the case of carbonisation with aluminium chloride the chambers are heated to 212—230° F.; and the goods must be passed more slowly than when carbonising them with sulphuric acid.

Light goods may also be carbonised by passing them over hot drums or over a stentering machine.

After being carbonised the goods are very thoroughly washed with water in the washer, and then, with the aid of blue litmus paper, carefully and exactly neutralized with diluted soda solution, until the acid reaction has disappeared; finally they are rinsed again with water.

The greatest care should be exercised in the proper neutralization of wool-dyed piece goods; this is amply repaid by the better results generally and the greater freshness of the shades in particular. As already mentioned above, special attention should be paid to having the greatest portion of the acid removed with water in the washer, before they are finally neutralized with soda. If this is omitted and the goods are neutralized with soda at the outset, the wool itself and the colours also are liable to suffer, for the neutralization of acid and alkali takes place within the goods, which is accompanied by the generation of heat within the fibre and therefore acts unfavourably both upon the wool and the colours.

As regards the choice of the carbonising agent, the preference must decidedly be given to sulphuric acid rather than to aluminium chloride whenever the dyestuffs used permit it.

Consequently, if one may choose between two dyestuffs, one withstanding aluminium chloride, the other sulphuric acid carbonisation, the preference should be given to the latter, for carbonising with aluminium chloride has certain disadvantages.

E. g. It is much more difficult to keep the aluminium chloride carbonising liquid up to the proper strength than sulphuric acid baths, because the areometer fails to indicate the strength after a short use of the carbonising liquid; moreover, pieces immersed in aluminium chloride have to remain longer at a higher temperature in the carbonising chamber, and this may easily cause great injury to the wool. Besides, the thorough neutralization and the removal of the alumina from the goods is incomparably more difficult than the neutralization with sulphuric acid and, lastly, the goods carbonised with aluminium chloride retain a nasty, unpleasant, sticky handle which affects the quality. All these drawbacks become still more apparent when the wool has not been washed quite clean, or residues of fat or soap have been left in the goods from the scouring or milling operations. In that case sticky alumina soaps are formed which spoil the appearance of the goods and give them a nasty, slippery handle; moreover they allow the dust to settle more easily upon made up clothes and render them uncomely in appearance.

Finally, the carbonisation with aluminium chloride is more expensive than with sulphuric acid. It is, therefore, only to be recommended when the dyer is obliged to use dyestuffs which cannot be carbonised with sulphuric acid, and when no other suitable dyestuffs are at his disposal. The choice of fast wool dyestuffs however is so great nowadays, that he will hardly experience any difficulty, and on a closer investigation he will find that it is again the chrome developing dyestuffs which — thanks to the fact that they can be carbonised with sulphuric acid — enable him to avail himself of this better method of carbonising and to deliver superior goods.

Formerly, there was, besides Indigo, only Alizarine Blue available as a blue dyestuff which could be carbonised with sulphuric acid, but now we have also the Chromotropes and Fast Mordant Blue. Acid Alizarine Brown, stable to sulphuric acid, can take the place of Alizarine Brown which can only be carbonised with aluminium chloride. Whilst the Alizarine Red brands are not fast to sulphuric acid, the Acid Alizarine Red brands and Dianil Fast Red withstand it well; Acid Alizarine Black has replaced logwood, which cannot be carbonised with sulphuric acid. Consequently, there is no longer any colour which cannot be produced by chrome developing dyestuffs in a manner stable to carbonising with sulphuric acid, so that it is now possible to dispense with the aluminium chloride carbonisation in dyeworks in which all kinds of wool-dyed goods are produced.

Final Finishing.

The final finishing operations to which the goods are subjected after scouring, milling and carbonising, affect wool-dyed goods comparatively less than the above-named processes. Concerning the effect of the final finishing operations upon the shades it may be remarked that those processes which are applied with heat, such as pressing, steaming and potting, act like an alkaline treatment, and, consequently, have a considerable effect upon the shades; in fact this effect is if any thing more pronounced than the one produced by the scouring, milling and neutralizing processes after carbonisation.

This is explained by the fact that wool, being itself an alkali, when heated splits off ammonia or other alkaline products. The tendency of the wool to react as an alkali when heated, is still increased by the removal, in milling and thorough washing which succeeds all operations, of all traces of acid (retained from the mordanting or the dyebath).

These then are the reasons why the final finishing operations carried out at a high temperature, viz., hot pressing, drying, potting and steaming, alter many shades in the same way as ammonia; e. g. Alizarine Blue is altered towards green, Alizarine Red and Alizarine Orange turn bluer and darker, Alizarine Yellow and Mordant Yellow appear deeper; other dyestuffs fast to alkali, such as Acid Alizarine Brown, Acid Alizarine Black and Indigo do not alter at all. Indigo turns redder through steaming and shrinking, especially when dyed in the hydrosulphite vat; this change however must not be attributed to any alkaline reaction, but is most probably due to a physical transformation; the Indigo is deposited within the fibre in an amorphous or minutely crystalline form, but when heated it is liable to sublimate and this brings about a change into a more pronounced crystalline state.

As a rule the change of the dyestuffs used in wool-dyeing produced by the final finishing operations, if it takes place at all, is only a slight one, and can easily be taken into account in matching, with proper knowledge of the properties of the dyestuffs.

Pale blue, pearl and silver shades are often changed by severe steaming. This is in most cases no fault of the dyestuffs, but is to be attributed to the fact that under the high pressure used in steaming, the wool fibre undergoes a minute decomposition, and turns yellowish or brownish, so that the small amounts of blue dyestuff are counteracted by this excess of yellow.

5. The Finishing of Shoddy-made Goods.

With regard to the further treatment and working of shoddy goods the following remarks are to be made:

After dyeing and washing the rags are dried and then torn in specially constructed machines, before being worked up into yarns by themselves or mixed with new wool or with cotton. It is, therefore, important that the rags are evenly and thoroughly dyed, lest the shades appear grey and mottled afterwards.

Shoddy goods which are to be milled, and contain either only shoddy yarns or are mixed with new wool or cotton, have to pass through all the same processes as pure wool goods (as has been described on page 76 etc.).

However, more care is generally necessary in these operations for shoddy goods; they should not be subjected to the reaction of strongly alkaline milling liquors, nor allowed to remain in a wet state after being washed, in order to obviate bleeding upon white or accompanying light shades. This precaution is necessary for several reasons. For, on the one hand, many colours cannot be dyed absolutely fast upon shoddy, i. e., at least as regards bleeding into white; the dyer is often compelled to employ products which yield bright but not very fast shades when he has to produce comparatively light effects upon dark material; on the other hand, dyestuffs, otherwise fast to milling, often fail to fix themselves sufficiently fast upon shoddy, owing to the original dyestuffs and mordants adhering thereto. Moreover, even the best dyed shoddy sometimes bleeds because the remains of the original dyestuffs may cause the defect.

Shoddy cloths which are not intended for milling are differently treated according to the various uses of the goods. Alkaline milling is replaced by neutral milling (cold water) or is omitted altogether; potting need not be considered at all; steaming consists at most in light dry steaming; in short, all aftertreatments are carried out in a much milder form, in proportion to the lower quality of the material and the corresponding choice of the dyestuffs. But even in these instances it is necessary to work with caution after dyeing. The goods must not be allowed to lie or be hung up in a wet state, particularly if previously treated with soap or other alkaline agents.

6. Mishaps in the dyeing of Loose Material.

Not infrequently irregularities and complaints occur during the finishing of the goods or when the pieces are being looked over: the shades are faulty, the handle not satisfactory, the goods show stains or are cloudy or knittery, the white is soiled, the colours rub off etc. etc.

Considering the great number of operations the goods have to pass through while being finished, it is very difficult to lay bare the causes of these defects which often disappear as suddenly as they appear.

It is, therefore, the object of the following lines to protect the dyer as much as possible from such mishaps, and to review briefly the ordinary causes of the most frequent defects. Of course, such a review cannot be an exhaustive one, considering the vast number of possibilities whereby mishaps may be caused, and can only deal with the most important ones.

Bad and imperfect washing of the wool, the presence of fat, lime soap and remnants of soap in the wool are the most frequent causes of the following evils: The wool is liable to dye unevenly, because the fatty tips of the fibres take up less mordant and dyestuff than the roots of the hairs; such wools require more mordant and dyestuff than perfectly clean ones; the dyebaths have often a muddy appearance; the dyestuffs are badly and imperfectly absorbed; the colours smear off; the finished goods look grey and lifeless, and plain-coloured goods have a knittery appearance; the wool felts in the dyebath; gloss and handle of the material suffer from the presence of fatty matter; the wools are not pliable; the shades are not fast to milling, allow some of the dyestuff to come off and bleed; the goods cannot be washed quite clean, and are therefore affected in the subsequent finishing process, so that they shrink too much in width and length, and are sticky when being calandered.

The wool is not sufficiently washed and neutralized after carbonisation. This defect causes a too rapid absorption of Indigo in the vat and, consequently, the resulting Indigo shades rub and are not fast to milling; when using mordant dyestuffs, the mordant is taken up too rapidly and irregularly; their fixation and, therefore, that of the colours is not even; the brightness of several mordant dyestuffs, as e. g., that of Alizarine Blue, Alizarine Red, is impaired; dyestuffs do not fix themselves well on alumina mordant; some of the chrome developing dyestuffs work on too quickly and dye unevenly.

The water used for the dyebath contains much lime or a considerable amount of organic matter: This produces bad absorption of the mordant and loss of dyestuff in dyeing; and consequently, a greater consumption of mordant and dyestuff, bad fixation of the colours, want of fastness of the shades to milling and bleeding.

The mordanting and dyebaths are heated too quickly and the material is too little manipulated: This causes unevenness in mordanting and dyeing, insufficient and only superficial fixation of the mordants and dyestuffs; consequently the shades are not fast to milling, and turn out uneven, streaky and cloudy. Under the same circumstances developing dyestuffs are too rapidly taken up by the fibre, and the shades are then apt to look mottled in plain-coloured goods.

The scouring is incomplete, unsaponifiable mineral oils remain in the goods: The goods have a bad handle and lustre; by the succeeding carbonisation the fatty substances are burnt into the goods and impart to them a cloudy appearance; also the pieces mill badly and unevenly.

In milling too strongly alkaline lyes are used, and the goods worked too hot and too dry: The effect shows itself in a considerable change of shade and loss of depth; the shades have a lean and ragged appearance, bleed and soil accompanying light shades, and are cloudy and often streaky. Indigo shades show a whitish appearance.

The pieces show longitudinal streaks and discoloured selvedges: If carbonised, and then neutralized pieces, or scoured and milled goods are allowed to remain for some time on racks (horses) in an unwashed state, the soda solution, gathering (siping) towards the selvedges, loosens the colour lake more than in the centre of the pieces, whereby the fastness to milling and bleeding is diminished along the selvedges.

If, through the two last-named defects melanges are soiled it is advisable to treat them in a bath prepared with 1—2% Hydrosulphite NF and 1—2% Bisulphite 72° Tw. or acetic acid, in order to improve the white or accompanying light shades.

The carbonisation is unequal: Imperfect penetration of the carbonising liquid; bad hydroextraction after impregnation; leaving the pieces rolled up or hung a long time over racks before being carbonised, cause wool-dyed goods to show stains, cloudiness and uneven selvedges; this is especially the case if the dyestuffs are somewhat sensitive to acid. Moreover, unequally carbonised goods often show an irregular behaviour in milling, whereby defects are created.

Bad, insufficient or improper neutralization of the carbonised rough cloth has a detrimental effect upon the shade, handle and appearance of the goods. If imperfectly neutralized goods are milled, fatty acids are separated which occasion cloudiness and stains.

Mildew stains appear most frequently in Indigo-dyed goods, which contain no chrome; they are to be found on pieces dyed in the fermentation vat oftener than on those dyed in the hydrosulphite vat, and are generally traced to damp storage of the wool or the pieces, but are also frequently caused by the use of old wooden scrays or racks, in the cracks of which mildew fungi grow rapidly. In most cases the removal of the injurious utensils is sufficient to cause the mildew stains to disappear; a good and sure remedy for their prevention consists in lining the wooden utensils with zinc.

As a rule it is easier to prevent defects in the manufacture of goods than to remedy faults once apparent. They often become noticeable only when already fixed in the goods by one or more of the subsequent operations, so that it is difficult, nay, often impossible, to remove them again. The best guarantee for the production of sound merchantable goods, therefore, is the conscientions carrying out of all measures necessary for the dyeing operation and those preceding and succeeding the same.

II. The Dyeing of Slubbing.

Slubbing or tops, the unspun preparatory product of worsted yarn, represent loose endless bands of the long-stapled wool fibres freed by combing from the shorter hairs, in which the separate fibres have been laid parallel to each other, without being twisted, by the preparatory combing process. They are very often dyed in this state. Tops and slubbing are dyed both for plain and for multicoloured goods, especially also for Melanges, because the dyed tops can easily and satisfactorily be mixed with white and other colours before undergoing any further process of manufacture.

The tops intended for dyeing are generally in a sufficiently cleansed state, as the wool before being combed into slubbing has already passed through the washing process in the loose state. If it is necessary to remove before dyeing the small amount of spinning fat that has got into the tops during the combing operation, boiling with pure water or a short luke-warm treatment with 1—3% ammonia will generally suffice. If the tops contain too much fat, they are scoured with about 2% soda at 122° F for $^1/_2$—1 hour and subsequently well rinsed.

The dyed tops being put to the most varied uses, the demands made upon the fastness of the colours vary very greatly.

Accordingly, in discussing the dyeing of slubbing, the following divisions may be distinguished in regard to the groups of dyestuffs to be considered:

1. Slubbing intended for heavy milling;
2. Slubbing intended for light milling;
3. Slubbing intended for knitting yarns and hosiery;
4. Slubbing intended for printing.

Before dealing with these four classes, we may touch upon the mechanical appliances which play an important part in the dyeing of tops and slubbing.

The mechanical appliances.

Formerly the dyeing of slubbing was carried out in the same manner as that of yarns. The tops were reeled and dyed over sticks in yarn-dyeing cisterns, whereby the looseness of the sliver necessitated its cautious manipulation during the dyeing operation. For the same reason, and in order to obviate as much as possible the felting of the material, vigorous boiling of the dye-liquid during dyeing is to be avoided.

Notwithstanding every caution in working, slubbing is always more or less entangled in dyeing, so that there is always a considerable loss in spinning and moreover the yarn produced is generally not very even. On the other hand the mechanical dyeing apparatus effect a considerable preservation of the material, for they keep it stationary whilst the dye-liquid is passed (pressed) through it; for this very reason they have been most widely adopted for dyeing slubbing. Thanks to the invention of the mechanical dyeing apparatus which was largely assisted by the progress of the tar colour industry, the dyeing of tops is nowadays playing a very important part in wool-dyeing.

As regards the appliances to be considered for top-dyeing, it cannot be the object of the present work to give an exact and complete description of all constructions pertaining thereto. We shall, therefore, only outline their characteristic features in so far as is necessary for the later discussion of the dyeing operations proper.

The slubbing which is dyed in the form of tops, i. e., of cylindrical rolls, differs advantageously from the wool in the loose state, when dyed in a mechanical apparatus. These rolls represent a structure which offers in all its parts the same resistance to the circulating liquid, whose even penetration presents, therefore, no difficulties, provided that the liquid is uniformly forced through, and not around, them.

In order to attain this it is necessary to dye the tops in vessels that fit closely to their outer contours; moreover, to be able to apply a vigorous circulation of the liquid by means of a pump which easily overcomes the resistance of the material, naturally greater in comparison than that of loose wool; and, finally, for the last-named reason, in dyeing tops on mechanical apparatus even more attention has to be paid to a good and perfect solubility of the dyestuffs used than in dyeing loose wool, because the evenly and firmly wound top acts upon any undissolved ingredients or sediments forming in the liquid like an exceedingly fine filter which retains all undissolved particles; if these are present in excess, the circulation of the liquid is as a matter of course impeded, and defective dyeings ensue.

The simplest mechanical apparatus is the one constructed on the packing system: the tops are placed into one or more pot-like receptacles with perforated bottoms arranged by the side of one another; they are closed by perforated lids which weigh down the tops through their own weight or are screwed down by other contrivances, so that the inner side of the vessel is everywhere in contact with the material. By means of a centrifugal pump the liquid is pumped out of the collector affixed to the bottom of the vessel, sprayed over the tops and penetrates the wool either by gravitation or by the pressure of the pump; the liquid collects again in the basin underneath the vessel, and the circulation is then repeated.

The so-called revolver apparatus, based on the same principle but constructed in a slightly different manner, are also much used. They contain, around a vertical tube, in one or more planes one above another, a number of receptacles each fitted with a perforated bottom and closed by a perforated lid; into each of these receptacles a top is placed. The whole apparatus stands in a vessel fitted with a pump, by means of which, when set in motion, the liquid is raised within the central tube, then distributes itself into the separate receptacles and, penetrating the tops flows back into the collector.

In so constructed apparatus it is advisable, for the production of even results, to change the direction of the liquid during the dyeing operations. This is accomplished either by interrupting the dyeing operation and turning and changing the tops or, in a still better and simpler manner, by suitable appliances which permit of the receptacles containing the material, being moved round by 180°, or, lastly, by reversing the circulation of the liquid.

Other apparatus are those of the creel system, which contain a contrivance for using tops with a hollow centre. These are stuck on perforated tubes, singly or 2 or 3 at a time which in their turn are placed on another perforated cylinder; the uppermost and lowest layers of the tops are then closed up. The whole stands in an apparatus fitted with a pump. The liquid penetrates the tops either from the inside to the outside or reserved; by reversing the pump the circulation of the liquid can be easily changed. The re-packing of the tops or the turning motion of the receptacles is consequently dispensed with in these apparatus which, therefore, offer some advantage over the previously described constructions.

Finally, there are some apparatus in use for dyeing tops which run on very similar lines to the Klauder-Weldon apparatus described in the dyeing of loose wool, and which strictly speaking, cannot be regarded, like these, as mechanical dyeing apparatus.

In these the slubbing is hung on to sticks which are fixed into the flanges of a hollow drum in such a way that the slubbing appears like the spokes of a wheel. The latter moves round a horizontal axis, and is immersed up to this axis in the dye liquid. When the cylinder revolves the slubbing dips alternately into the liquid which gradually penetrates and dyes the material so that an even result is attained.

As already mentioned, the introduction of mechanical dyeing apparatus has given a great impetus to top and slubbing dyeing; they are at present almost exclusively dyed in mechanical machines and dyeing in hanks has been given up almost entirely. All methods for dyeing slubbing must therefore, in the first place be so chosen that they can be carried out in an apparatus; and no methods or dyestuffs that fail to satisfy these demands can be considered suitable for slubbing dyeing, and may, consequently, be neglected in the following discussions. In the few cases where the slubbing is dyed in the state of loose hanks, the solubility of the dyestuffs is not of such vast importance, and then the dyeing is ruled by the same principles as that of yarn dyeing in open dye vessels; we may therefore refer for these purposes to the corresponding chapters on yarn dyeing.

I. The Dyeing of Slubbing for heavy milling.

Slubbing intended for goods which have to undergo heavy milling, is expected to possess the utmost fastness to milling, wear and light, and the same dyestuffs have therefore to be considered as are used in dyeing loose wool, i. e., Indigo and the fastest of the other dyestuffs from the Mordant, Alizarine and Chrome developing dyestuffs.

The number of shades required is very numerous and far less limited than in the case loose wool dyeing.

In the following lines we propose to deal with the dyestuffs suitable for that purpose and their employment, arranged according to the principal colours in use.

1 % oxalate of ammonia
20 % **Acid Alizarine Black SE paste**
5 % acetic acid, 2 % sulphuric acid
2,5 % bichrome.

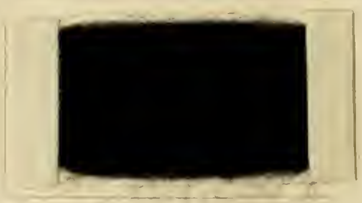
Black.

As for dyeing loose wool, the dyestuffs chiefly to be considered for dyeing slubbing intended for heavy milling are our Acid Alizarine Black brands.

Owing to Acid Alizarine Black SE and SET not dissolving very easily, some caution is necessary in their use for dyeing slubbing and special regard must be had to the good solution of the dyestuffs. The following manner of operating is, therefore, to be followed:

The dyebath, for which water of the greatest possible softness, free from lime, should be used, is prepared at first with 1—2 % oxalate of ammonia and the requisite amount of well dissolved dyestuff which must be added to the bath through a sieve. The temperature is raised to nearly boiling point, the apparatus set in motion, the bath heated to the boil, and boiling continued for ½ hour. Then 6—8 % acetic acid are added in several portions, most conveniently by means of a dripping funnel, in order to exhaust the bath, but the Acetic Acid may also be partly replaced at the close of the dyeing process by 1—2 % sulphuric acid. The bath being exhausted, 2—3 % bichrome is added and the shade developed by boiling for ¾—1 hour.

8 % **Acid Alizarine Black SN**
3 % acetic acid; 1,5 % sulphuric acid
2,5 % bichrome.



If the material is very firmly packed, a little ammonia must be added at the outset of the dyeing operation, so that the bath has a slightly alkaline reaction, and after boiling for ½ hour the same manner of working as stated above is continued.

7% **Acid Alizarine Black SNT**
3% acetic acid; 2,5% sulphuric acid
2,5% bichrome.

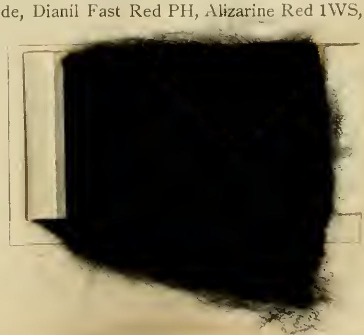
In operating with the very soluble and, consequently, for apparatus dyeing more suitable Acid Alizarine Black SN and SNT, the goods should be entered at 122° F into the dyebath which has been prepared with the dissolved dyestuff and 3—5% acetic acid; when using copper vessels it is necessary to add first 3½ oz ammonium sulphocyanide to every 200 gallons of liquid. The pumping apparatus being set in motion, the temperature is raised to the boil, and boiling continued for ½ hour. By means of a dripping funnel 2—3% sulphuric acid are then slowly added, and after the bath is exhausted and boiling has been continued for another ½ hour, the blacks are developed with 2—3% bichrome and the whole boiled further for ¾ hour.

Combined with Patent Blue A and Fast Acid Violet for lighter shades, Acid Alizarine Black SE as well as SN, owing to their bright plummy shade yield blueblacks to darkblues. These are much used on account of their great fastness.

The shades obtained with Acid Alizarine Black SE, SET, SN and SNT upon tops satisfy all demands made upon them; they are fast to wear, light, bleeding and milling, so that they do not bleed into white or light accompanying colours nor change their shade when heavily milled. They therefore take the foremost rank in the production of fast blacks upon upon tops and slubbing.

Acid Alizarine Black R and the other kindred brands, such as RH, 3B, 3B extra, T etc., do not, indeed, lay claim to the same superiority as regards fastness to bleeding as the afore-mentioned brands, but are in most cases also satisfactory for blacks fast to milling upon tops. Easily soluble, capable of being dyed from the beginning in an acid bath, reliable as to accuracy of shade, also very fast to wear and extremely so to light, they are used most extensively for slubbing dyeing. Even for goods subjected to heavy milling they can be used almost throughout without hesitation. They are worked in the following manner: The bath is prepared at 104—122° F with 10% Glauber's salt, 2% sulphuric acid and the requisite quantity of the dissolved dyestuff (after having added, when using copper apparatus, 3½ oz ammonium sulphocyanide to every 200 gallons fluid, in order to neutralize the injurious reaction of the metal). The apparatus is then set in motion, the temperature raised to the boil within ½ hour, and during boiling for an hour 1—2% sulphuric acid are added in order to exhaust the bath. Finally, the shade is developed with 1½—2½% bichrome, and boiling continued for 20—30 minutes. For shading Acid Alizarine Black brands the following are used: Fast Mordant Blue, Acid Alizarine Violet, Acid Alizarine Grenade, Dianil Fast Red PH, Alizarine Red 1WS,

4,5% **Acid Alizarine Black R**
0,75% **Fast Mordant Blue B**
0,1% **Mordant Yellow O**
10% Glauber's salt, 2% sulphuric acid; 2% sulphuric acid
3% bichrome.



[illegible] Yellow GGW, [illegible] Alizarine Yellow RC, moreover Patent Blue A, Fast Acid V[illegible], Milling Blue 2R extra, [illegible] T, the latter in not too large quantities.

With a view to quicker working and in order to save steam and time, Acid Alizarine Black is frequently dyed in one bath and then chromed in another.

All brands of Acid Alizarine Black can also be dyed on previously mordanted goods, and in that case are used in combination with Alizarine Blue and Fast Mordant Blue for the production of the dark shades. In that case it is necessary for the sake of better fixation to add at the close of the dyeing operation ½—1% bichrome, and continue boiling for another ½ hour.

Blue.

The best and fastest blue shades upon slubbing are obtained by means of **Indigo**, the employment of which in a mechanical apparatus, especially for dark shades, has been rendered possible by the introduction of our hydrosulphite vat, which is free from sediment.

Indigo, dyed with **Indigo MLB Vat I**
in the hydrosulphite vat

In order to avoid the troublesome re-packing in dyeing, the method of acidifying the vat is adopted, as has already been explained in discussing the dyeing of loose wool on mechanical apparatus (p. 23). To prevent unnecessary repetitions, we therefore refer to those descriptions which also apply to the dyeing of slubbing.

Thanks to the absence of free alkali in the vat, further in consequence of the short time of the dyeing process, and the possibility of producing even dark blues in one dip, the Indigo dyed slubbing has a loose open handle and is very pliable in spinning. The dyeing of slubbing with Indigo must therefore be regarded as the best method, not only in respect of the fastness, but also as to the quality of the goods manufactured from these tops.

Indigo, dyed with **Indigo MLB Vat I**
in the hydrosulphite vat.

Of chrome developing dyestuffs for blues fast to milling, besides those already alluded to in the previous chapter produced with Acid Alizarine Black, the following are to be chiefly considered: Fast Mordant Blue B and R, Chromotrope FB, F4B, DW, and Acid Alizarine Blue BB.

The above-named Chromotrope brands are very soluble, which makes them suitable for apparatus dyeing. In using them however account must be taken of the fact that they are sensitive to bright copper, the action of which impairs their fastness and causes the shade not to turn out as deep and full as under normal conditions. It is, however, possible to work

3,5% **Chromotrope DW**
0,5% **Patent Blue A**
0,125% **Mordant Yellow O**
10% Glauber's salt, 4% sulphuric acid
3% bichrome, 1% sulphuric acid, 2% lactic acid.

without any ill effect in copper apparatus, as long as these are not bright but covered with a protective layer of oxide. Moreover, the harmful effect of copper can be counteracted by the addition of 3½ oz ammonium sulphocyanide to every 200 gallons dye liquid.

Chromotrope FB, F4B and DW are first dyed in a sulphuric acid bath and developed with bichrome, lactic acid and sulphuric acid. Chromotrope FB yields the reddest, F4B the greenest shades, while DW stands between the two. For shading Alizarine Red 1WS, Acid Alizarine Grenade R, Acid Alizarine Violet N, Mordant Yellow O, Acid Alizarine Black, Patent Blue A etc. are used. Chromotrope FB has a tendency to bleed in milling, especially when the goods have been allowed to lie unwashed and wet longer than necessary; it should, therefore, be used with caution for goods to be subjected to heavy milling and which contain light accompanying shades. In that respect Chromotrope F4B and DW are better, and will satisfy most demands as to fastness to bleeding.

4% **Chromotrope F4B**
0,5% **Patent Blue A**
0,5% **Fast Acid Violet R**
10% Glauber's salt, 4% sulphuric acid
3% bichrome, 1% sulphuric acid, 3% lactic acid.

Concerning the other fastness properties of the Chromotropes it may be mentioned that all three brands are very satisfactory as regards fastness to light, rubbing and wear; in matching, however, regard should be had to the fact that Chromotrope FB and F4B turn somewhat redder in milling and steaming, behaving therefore contrary to Alizarine Blue, whereas Chromotrope DW scarcely changes at all under these treatments.

Fast Mordant Blue R and B, which also have the advantage over the three Chromotrope brands that they yield fast blue lakes on previously mordanted material are rather better than Chromotrope DW in respect of fastness of the chromed shades. In their employment as chroming developing dyestuffs, Fast Mordant Blue B and R are further distinguished for

3% **Fast Mordant Blue R**
0,3% **Acid Alizarine Grenade R**
0,4% **Patent Blue A**
10% Glauber's salt, 3% acetic acid; 2% sulphuric acid
2% bichrome.

[illegible] bichrome and [illegible] lactic acid for developing the shade, whereby the [illegible] great pliability of the material is preserved. Regarding fastness to light, [illegible], potting, rubbing and alkali, Fast Mordant Blue B and R satisfy all demands that can be made upon dyestuffs intended for dyeing goods fast to milling. Considering their good solubility and [illegible] properties the Fast Mordant Blues are undoubtedly destined to play a great part in slubbing dyeing.

In using them, iron vessels must be avoided, because they turn the shade brown; the injurious action of copper upon the shade can be obviated by the addition of 3½ oz ammonium sulphocyanide to every 200 gallons liquid. Fast Mordant Blue is first dyed with 10—20% Glauber's salt and 3% acetic acid; 2—3% sulphuric acid are then added, and after boiling for an hour the shade is developed with bichrome or chromium fluoride. Of the former about half the quantity, of the latter the same quantity as that of the dyestuff used is necessary.

2.5% **Acid Alizarine Brown BB**
0.4% **Patent Blue A**
0.3% **Acid Violet 5BF**
10% Glauber's salt, 4% sulphuric acid

4% fluoride of chrome

If Fast Mordant Blue is dyed on previously mordanted goods, the same method is followed as with mordant dyestuffs. Considering the good solubility of the dyestuffs, however, an initial boiling with ammonia, such as is necessary, e. g., for Alizarine Blue to get the material well dyed through, is not required in apparatus dyeing. In order to enhance the fastness to milling of Fast Mordant Blue R and B on previously mordanted goods some bichrome is added at the close of the dyeing operation; the tenth to fifth part of the quantity of dyestuff used suffices.

If the property of Fast Mordant Blue R and B to form fast lakes on previously mordanted goods leads us to discuss the blue mordant dyestuffs, amongst which Alizarine Blue stands foremost, we may, before doing so, mention Acid Alizarine Blue BB which, although a derivative of Alizarine, is to be used after the method of the chrome developing dyestuffs, and is of special interest also for top dyeing.

3% bichrome, 2.5% tartar

25% **Alizarine Blue DNW paste**
2.5% acetic acid

Acid Alizarine Blue BB is dyed either in one or two baths which can be used over [illegible]ot. The dyebath is prepared with 25% Glauber's salt and 3—4% sulphuric acid; the liquid is brought into circulation, and the dissolved dyestuff is slowly added. After boiling for 1 hour the steam is turned off, and 3—4% fluoride of chrome are added by means of a dropping apparatus, after which the shade is developed by boiling for 1—1½ hours. Darker blue shades are obtained by the addition of Alizarine Red 1WS and Mordant Yellow O. Seeing that fluoride of chrome reacts upon copper, it is necessary to employ either zinc-lined apparatus or such as are covered from previous operations with a protective layer of oxide, otherwise ammonium sulphocyanide must be added to the dyebath.

The blue shades obtained with Acid Alizarine Blue BB, though somewhat more sensitive to alkali than those obtained with the above-named dyestuffs or with Alizarine Blue, offer absolute safety as regards bleeding, and as the milling of tops is often not a severe or strongly alkaline one, Acid Alizarine Blue BB can be employed in many cases without hesitation. Moreover, if the tops are rinsed with acetic acid after milling, as is frequently done, the change of shade, even in heavy milling, of Acid Alizarine Blue BB is reduced to a minimum.

Of the genuine mordant dyestuffs Alizarine Blue is to be considered for blue shades. As it is essential when employed in apparatus dyeing, that the colour be properly dissolved, two methods can be followed, which depend upon the employment of either the ordinary Alizarine Blue brands, or their bisulphite compounds, the "S" brands. The difference between these two groups has been discussed already in the chapter on "loose wool" (page 28). As for the mode of employing Alizarine Blue, we refer to the particulars given about the general dyeing methods, in vol I, page 139 and 140, which deal with apparatus dyeing of the Alizarine Blue brands and the dyeing of the "S" brands.

We must again draw attention to the fact that blue shades dyed with Alizarine Blue are the better dyed through, the less lime there is present in the water used for dyeing; it is there, fore best to work with condensed or purified water. If no water free from lime be available, the unevenness of the first lot must be put up with, and working be continued in old baths. In that case the liquid, after allowing it to cool down, is neutralized with ammonia, then further 2—3% ammonia are added, and the same operation as with the first lot is repeated.

The blue shades produced with the Alizarine Blue brands are distinguished for excellent fastness properties, and satisfy all demands made upon the fastness of slubbing intended for men's materials. They are shaded off, according to the desired shade, with Ceruleine, Galleine, Alizarine Red 1WS, Mordant Yellow O, Acid Alizarine Yellow RC, Fast Mordant Blue, Alizarine Brown etc.

Among the Alizarine Blue dyestuffs we must finally mention Alizarine Direct Blue B which is extremely valuable for the production of fast blue shades upon tops, thanks to its superior fastness to wear and light and the general properties which must be considered in the process of manufacture, such as fastness to milling, steaming and carbonising, as well as the brightness of the shade. According to the demands made upon the goods in their manufacture, the colour is applied either simply in an acid bath or upon previously mordanted goods, or with the view to producing the greatest possible fastness, by aftertreatment with bichrome, after the manner of the chrome developing dyestuffs. For shading off a number of dyestuffs may be used corresponding to the mode of dyeing employed, viz: Alizarine Blue or Fast Mordant Blue, Alizarine Yellow etc., if dyed upon previously mordanted goods; Fast Mordant Blue, Chromotrope, Mordant Yellow, Acid Alizarine Red etc., if dyed after the manner of the chrome developing dyestuffs; or Fast Acid Violet, Milling Blue, Patent Blue A, Milling Yellow, Flavazine T etc., if dyed in an acid bath.

Alizarine Direct Blue B is of special interest for producing bright and light shades, which owing to their purity, their green evening shade and their excellent fastness to wear, occupy at least the same rank as those obtained with Alizarine Blue. They stand moderate milling well, and although not absolutely fast to bleeding, will practically satisfy all demands, even as regards heavy milling, especially if the goods are treated with the necessary caution in milling, and the shades are moderately light. Alizarine Direct Blue B shows the same advantages over Alizarine Blue as the first-named Chrome developing dyestuffs, viz: a considerably better preservation of the quality of the tops, combined with a simpler, quicker and safer mode of working.

Green and Olive.

In order to produce green and olive shades fast to milling upon slubbing, Indigo is used for grounding, and then topped according to the desired shade.

The grounding with Indigo upon tops is effected in the same manner as described in discussing the blue shades. On the Indigo ground so obtained pure green shades are produced by topping the same in an acid bath with Mordant Yellow O; if necessary, with

Indigo, topped with
1% **Mordant Yellow O**
0,38% **Patent Blue A**
10% Glauber's salt, 3% sulphuric acid.
1% bichrome.

the addition of Patent Blue A, and subsequently developing the chrome developing dyestuffs with bichrome.

Darker green and olive shades are obtained by topping the comparatively darker Indigo ground either with Acid Alizarine Grey G, Acid Alizarine Brown B, and Mordant Yellow O, or with Chromotrope FB, F4B, DW and Mordant Yellow O, or with Fast Mordant Blue R, B, Mordant Yellow O and Acid Alizarine Brown B. The last and the first combination are preferable to the second which requires larger amounts of chrome for the fixation of the Chromotropes, whereby a partial destruction of the Indigo ground is easily brought about. This may, however, be avoided by adding lactic acid in chroming, in addition to bichrome.

If it is desired to work direct, viz without an Indigo ground, it is possible to obtain very fast green and olive shades by combining Acid Alizarine Black SE or SN or Acid Alizarine Blueblack 3B with Mordant Yellow O or Acid Alizarine Yellow RC, which combinations can be shaded off with Fast Mordant Blue B and Patent Blue A or Alizarine Direct Green G for brighter and greener shades, and with Acid Alizarine Brown BB for duller shades, which incline towards brown. The dyeing method for either Acid Alizarine Black SE or SN is guided by the rules laid down for apparatus dyeing with these dyestuffs. In order, therefore, to avoid unnecessary repetitions, we refer to the particulars given on page 92 etc. regarding the employment of these dyestuffs for black.

2.25% **Acid Alizarine Black SN**
0,8% **Mordant Yellow O**
0,5% **Patent Blue A**
0,5% **Acid Alizarine Brown BB**
10% Glauber's salt, 3% acetic acid; 1.5% sulphuric acid
2% bichrome.

Green shades superior in brightness to those obtained with Acid Alizarine Black, and excelling them somewhat in point of fastness to light, without being inferior to them in any other respect of fastness, are produced with Fast Mordant Blue R or B and Mordant

2% **Fast Mordant Blue B**
0,5% **Mordant Yellow O**
0,5% **Patent Blue A**
10% Glauber's salt, 3% sulphuric acid
2% bichrome.

Yellow O, if necessary, with the assistance of Patent Blue A. This combination is especially suitable for apparatus dyeing, on account of the easy solubility of the dyestuffs, and is further distinguished for requiring comparatively little bichrome for the development of the shade. The bath is prepared with 10% Glauber's salt, 2—3% sulphuric acid and the requisite quantity of dyestuff, dyeing being commenced at 122—140° F., the bath heated to the boil; if necessary, a further 1—2% sulphuric acid is added, and boiling continued for 3/4 hours. Bichrome is then poured in (half the weight of the dyestuff used) and boiling continued for further 3/4 hours. When working in bright copper apparatus it is necessary to add to the bath some ammonium sulphocyanide before starting the dyeing operation.

3% **Alizarine Direct Green G**
0,75% **Alizarine Direct Blue B**
10% Glauber's salt, 5% acetate of ammonia
2,5% acetic acid; 2% sulphuric acid
2% bichrome.

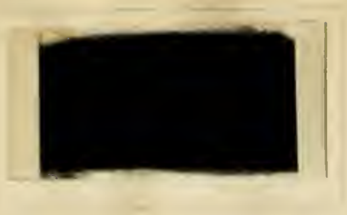
Similar green shades are obtained by using Chromotrope FB, F4B and DW instead of Fast Mordant Blue. Dyeing is carried out in the same way as stated above, but the shades are developed by the addition of bichrome, lactic and sulphuric acid, as described on page 50.

Acid Alizarine Green G is likewise to be recommended for the production of green shades fast to milling in a mechanical apparatus. The procedure is the same as with Acid Alizarine Blue BB (compare page 96), but rather more care must be exercised in adding the acid; for developing, fluoride of chrome answers as well as bichrome. In developing with fluoride of chrome it is necessary to proceed as was stated for Acid Alizarine Blue BB, for counteracting the injurious effect of the fluoride of chrome. Acid Alizarine Blue BB, Fast Mordant Blue B, R, Mordant Yellow O, Alizarine Red 1WS are suitable for development with fluoride of chrome, and the same dyestuffs with the exception of Acid Alizarine Blue BB can also be developed with bichrome. For shading off in smaller quantities and after the addition of chrome, the following are used: Patent Blue A, Fast Acid Violet and Milling Blue 2R extra.

3% bichrome, 2,5% tartre
4% **Alizarine Blue DNW paste**
1,5% **Patent Blue A**
1,5% **Mordant Yellow O**
2×5% acetic acid.

Alizarine Direct Green G is of very great interest for the production of fast green shades on slubbing. This dyestuff, which can be employed both as an acid and a chrome developing dyestuff, and can also be dyed on previously mordanted material, shows very satisfactory fastness to water, milling and alkali, excellent fastness to light, and being also fast to rubbing, steaming and carbonising, withstands all finishing operations and is sufficiently fast to wearing.

In consequence of the variety of its dyeing methods, Alizarine Direct Green G can be used in several ways. It either serves for topping slubbing which was grounded with Indigo; or as a foundation for the production of green shades in combination with the chrome developing dyestuffs, or, lastly, it can be dyed, together with the mordant dyestuffs, upon pre-



3 % bichrome, 2,5 % tartar

15 % **Alizarine Blue SBW paste**
1,25 % **Patent Blue A**
1,5 % **Mordant Yellow O**
2,5 % acetic acid.

viously mordanted material. Used by itself, it yields bright bluegreen shades which are employed either as self shades or shaded off with Alizarine Yellow GGW, Mordant Yellow O etc. If goods are dyed with Alizarine Direct Green G alone, acid dyeing, distinguished for excellent fastness to milling and bleeding, satisfies in most cases all demands, though it is still surpassed in that respect, when dyed on previously mordanted material, or even more so when developed with chrome. The latter methods are therefore to be preferred whenever the consideration for white or light accompanying shades demands good fastness to bleeding.

Of mordant dyestuffs which claim interest for the production of green and olive shades fast to milling upon tops, we have to mention, in the first place — in addition to the Alizarine Blue brands to be combined with Mordant Yellow O or Alizarine Yellow GGW and Patent Blue A, and to be used as described in the foregoing paragraph — the Ceruleines, all of which are employed in apparatus dyeing upon chrome mordant. In order to obtain a good penetration of colour, and to avoid the filtration of undissolved particles of dyestuff floating in the comparatively small amount of water, the brands Ceruleine paste A and conc., as well as the purer and bluer brands paste B, BR paste and BWR powder, are used as follows. The dyebath is prepared with the requisite quantity of dyestuff and 2—3 % ammonia, so as to impart to it a slightly alkaline reaction. The pump is then set into motion and the bath heated to boiling point. After boiling for about an hour, 5—10 % acetic acid, are then added, by preference through a dripping apparatus till the bath is exhausted, and boiling continued for another hour.

3 % bichrome, 2,5 % tartar

5,5 % **Ceruleine A paste**
0,55 % **Alizarine Brown paste**
0,28 % **Alizarine Blue DNW paste**
2,5 % acetic acid.

The same method is followed in working by the single bath method, i. e., when intending to proceed with the dyeing in the mordanting bath. Even then it is necessary to neutralize the mordant bath before dyeing by the addition of ammonia until a distinctly alkaline reaction is seen. The further operation is the same as stated above and as described in greater detail in discussing the general methods of dyeing (vol. 1, page 140).

The brands Ceruleine SW paste, S and S conc. which, being bisulphite compounds, are more soluble than the brands named hitherto, are therefore most suitable for the dyeing of slubbing in a mechanical apparatus. In using them, the same mode of operation as that described for bisulphite dyestuffs in vol. 1, page 139 is followed.

Ceruleines are shaded off, according to requirements, with Alizarine Blue, Fast Mordant Blue, Alizarine Direct Blue B, Alizarine Direct Green G, Patent Blue A, Alizarine Brown, Mordant Yellow and Acid Alizarine Yellow RC. Thus, bright green shades are obtained by a combination of the Ceruleine B brands with Alizarine Direct Green G, Patent Blue A and Mordant Yellow O; darker green shades with Ceruleine A paste and Alizarine Direct Blue B Alizarine Blue SBW or DNW and Mordant Yellow O, whilst olive shades are produced by using Ceruleine paste A, Alizarine Blue A and Alizarine Brown.

In conclusion we may mention Alizarine Green S, which is to be considered for the purpose of grounding darker shades of green and olive. It is employed in a similar manner to the Ceruleine S brands.

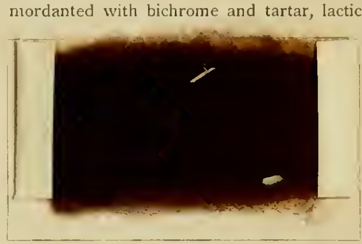
With regard to the fastness of green and olive shades produced with mordant dyestuffs on the one hand, and with chrome developing dyestuffs on the other hand, it may be said that they are equivalent in point of fastness to alkali, milling or light. Respecting fastness to rubbing, evenness and reliability for dyeing through, the shades obtainable with Ceruleine and the other mordant dyestuffs upon previously mordanted material are inferior to those produced with chrome developing dyestuffs and Alizarine Direct Green G. The same applies in greater measure to the preservation of the quality of the material, which is easily explained: For the mordant dyestuffs not only require the material to be dyed for a longer time, owing to its having first to be boiled, but they also necessitate initial boiling in an alkaline dyebath, which impairs the softness and openness and, consequently, the spinning capacity of the slubbing.

Considering the sum total of their properties, the first named combinations of the chrome developing dyestuffs deserve the preference over the shades obtained with Ceruleine and the other mordant dyestuffs.

Brown.

For brown shades obtained with mordant dyestuffs we have to consider Alizarine Brown which is dyed upon material previously mordanted with bichrome and tartar, lactic formic or sulphuric acid. For purposes of apparatus dyeing the powder brands, being soluble alkali salts, are more suitable than the paste brands.

5% bichrome, 2,5% tartar
2% **Alizarine Brown powder**
0,5% **Alizarine Yellow GGW powder**
0,1% **Alizarine Orange powder**
2×2,5% acetic acid.



In that case the dyebath is prepared with the dyestuff which has previously been dissolved, by preference in condensed water; the goods are entered at about 104° F., heated to the boil, and after boiling for 1/2 hour 5% acetic acid are added in order to neutralize the alkali salt and to exhaust the emainder of the dyestuff. For shading off the following are used: for yellow brown shades Alizarine Yellow GGW or Mordant Yellow O; for redder shades Alizarine Red 1WS or Alizarine Orange N powder, for dark brown shades Alizarine Blue DNW, Ceruleine A paste, Alizarine Direct Green G or Fast Mordant Blue B and R.

3,25% **Acid Alizarine Brown BB**
1,1% **Mordant Yellow O**
0,5% **Acid Alizarine Red G**
10% Glauber's salt, 3% sulphuric acid
2,5% bichrome.

[illegible] Acid Alizarine Brown B
[illegible] Acid Alizarine Black SE powder
[illegible] Acid Alizarine Yellow RC
[illegible] 5% [illegible] 2% sulphuric acid
[illegible] bichrome

If, instead of the powder brands, the Alizarine Brown paste brands are used, the same process as indicated for Alizarine Blue and as previously described in detail (vol. I, page 139) is to be followed, i. e., the dyebath must be made alkaline with ammonia at the outset, in order to effect an even penetration of the material.

About the mordant, it may be remarked that for fuller brown shades which are shaded off with much mordant yellow it is advisable to mordant the material with bichrome and sulphuric acid, in order to enhance the fastness to bleeding; also, that for very deep shades some bichrome or fluoride of chrome must be added at the close of the dyeing operation, in order to improve the fastness to milling.

In the same degree as the green and blue shades produced with chrome developing dyestuffs are superior to those produced with mordant dyestuffs (as regards the preservation of the softness and pliability of the slubbing), Alizarine Brown is surpassed by the chrome developing dyestuffs which are suitable for brown shades.

Foremost among the latter are to be mentioned Acid Alizarine Brown R, B, BB, RP and T. All these brands are easily soluble in water, can be dyed direct in a sulphuric acid bath, and yield exceedingly fast brown shades when developed with bichrome. Dyeing is carried out with the addition of 10% Glauber's salt and 3—4% sulphuric acid; the material is entered hot, and the shade developed after boiling for an hour by adding 2%, for very dark shades up to 4% bichrome. It is admissible to use old baths over again, only care has to be taken not to work them too acid, as the shades then tend to come up lighter. For this reason it is more economical to work in separate dye and developing baths.

0,75% **Fast Mordant Blue B**
0,9% **Mordant Yellow O**
0,9% **Acid Alizarine Red B**
10% Glauber's salt, 3% sulphuric acid
2,5% bichrome

Goods can be dyed with Acid Alizarine Brown in copper, lead and tin apparatus, the shade is impaired, however, by iron. All chrome developing dyestuffs are suitable for shading off, especially Alizarine Yellow GGW, Mordant Yellow O, Alizarine Red 1WS, Acid Alizarine Red G and B, Acid Alizarine Grenade R, Acid Alizarine Violet N, Fast Mordant Blue R, B, Acid Alizarine Black SE, Chromotrope FB, F4B, DW, also for shading off in smaller percentages, after the chroming, such fast acid dyestuffs as Patent Blue A, Milling Blue 2R extra, Fast Acid Violet etc.

Full darkbrown shades of superior fastness to milling are obtained, e. g., with Acid Alizarine Brown BB, Acid Alizarine Black SE and Mordant Yellow O; if, in such cases, larger quantities of Acid Alizarine Black are used, dyeing must be begun in a neutral bath containing some ammonia, as prescribed for Acid Alizarine Black (page 92). Red brown shades are obtained by combining Acid Alizarine Brown R, RP or B with Alizarine Red 1WS and Mordant

Yellow O, or with Acid Alizarine Grenade R and Mordant Yellow O, whereas brown shades inclining more towards olive are obtained with Acid Alizarine Brown B or T, Mordant Yellow O and Fast Mordant Blue B or R, or instead of the latter with Chromotrope DW and F4B.

In all these cases a better preservation of the material is ensured than it is possible to obtain on previously mordanted slubbing with Alizarine Brown, and the fastness to milling, rubbing and wear of the shades so produced is as good and partly better than that obtained with Alizarine Brown.

Furthermore, fast brown shades satisfactory as regards fastness properties and price can be produced with the chrome developing dyestuffs hitherto mentioned. Thus, Acid Alizarine Black SE or R, Alizarine Red 1WS and Mordant Yellow O can be combined for dyeing brown shades; also, combinations of Fast Mordant Blue R or B, Acid Alizarine Red or Acid Alizarine Grenade R and Mordant Yellow O dye easily, equalize well, and yield very fast browns.

The superior fastness of the shades obtained with Acid Alizarine Brown, their cheapness and quick application have helped to introduce Acid Alizarine Browns within a comparatively short time, and to supplant to a large extent Alizarine Brown in slubbing dyeing. Moreover the introduction of Acid Alizarine Brown has greatly decreased the demand for two of the older chrome developing dyestuffs, Chromogen I and Chrome Brown RO; still for certain purposes these colours are often resorted to and they deserve to be mentioned on account of some excellent qualities.

Whilst Acid Alizarine Brown can also be dyed on previously mordanted material, and yields upon the same almost as fast lakes as when developed by chroming, Chrome Brown shows similar characteristics to Chromotrope FB; it is a dyestuff which must be developed by an aftertreatment with chrome; it requires for its thorough development rather strong acid and chrome baths, and is best developed with bichrome, lactic and sulphuric acid. Dyed in a sulphuric acid bath and developed as described, Chrome Brown yields bright and full brown shades which can be shaded off at will, with Chromotrope FB, F4B, DW, Fast Mordant Blue R, B, Alizarine Red 1WS, Acid Alizarine Grenade R, Mordant Yellow O, and Alizarine Yellow GGW. The fastness to bleeding, milling and light of the shades so obtained, though not on a level with those produced with Acid Alizarine Brown, is in many cases sufficient.

2% **Chrome Brown RO**
0,3% **Mordant Yellow O**
0,6% **Alizarine Red 1WS powder**
0,2% **Acid Alizarine Grey G**
10% Glauber's salt, 5% acetic acid; 2% sulphuric acid
2% bichrome, 2% lactic acid, 1% sulphuric acid.

Shades which are absolutely fast to milling and so fast to acid that they stand topping in an acid bath, can be obtained with Chromogene I; these shades however are not so fast to light as those obtained with Alizarine Brown or Acid Alizarine Brown. Chromogene I is dyed either in one or two baths, both being used over again at the boil. The material is first dyed with Chromogene I, 10% Glauber's salt and 4% sulphuric acid, and then developed with 1—3% sulphuric acid and 3—6% bichrome. Care must be taken however that a sufficient quantity of bichrome be used, and that the bath be kept sufficiently acid during this operation. Chromogene I, which is suitable, above all, for producing light shades, is shaded off with Alizarine Red 1WS, Mordant Yellow O and Patent Blue A. The excellent equalising property, good fastness to rubbing and absolute fastness to milling of the Chromogene shades are features which stand out yet unsurpassed as compared with the shades obtained with Alizarine Brown and combinations of logwood, fustic, Alizarine Red and Alizarine Orange; on the other hand it must be admitted that Chromogene has been outclassed by the Acid Alizarine Brown brands, as regards fastness to light, and cheapness.

[illegible] % bichrome, [illegible] tartar

2 % **Alizarine Red 1WS powder**
0,45 % **Alizarine Brown paste**
0,4 % **Alizarine Blue DNW paste**
2,5 % acetic acid.

Copper, Claret and Currant.

Whilst pure red shades fast to milling upon slubbing for men's suitings are scarcely in demand, except for effect threads, and will therefore, be treated in a later chapter devoted to the production of bright decorative shades, the quieter red shades, such as copper, claret and currant, are more required.

Prior to the introduction of the chrome developing dyestuffs copper shades were produced mostly with Alizarine Orange N upon bichrome-sulphuric acid mordant, claret and currant shades upon the same mordant with Alizarine Red and Alizarine Grenade; and they were shaded off with Alizarine Yellow GGW or Mordant Yellow O towards yellow, with Alizarine Blue or Ceruleine towards blue, and Alizarine Brown was used for toning down. But the shades so produced cannot be pronounced particularly fast; they change their shade in heavy milling and steaming fairly considerably, and are especially liable to bleed in milling.

2 % **Acid Alizarine Red G**
2 % **Acid Alizarine Grenade R**
0,8 % **Mordant Yellow O**
10 % Glauber's salt, 3 % sulphuric acid

2,5 % bichrome.

Far better results are obtained with the red chrome developing dyestuffs Acid Alizarine Red G and B, Acid Alizarine Grenade R, Acid Alizarine Violet N, to which may be added Alizarine Red 1WS and Dianil Fast Red PH, both to be developed with bichrome in an acid bath. All the above-named dyestuffs are of very good solubility for the purposes for apparatus dyeing and, with the exception of the one last mentioned, possess very satisfactory equalising properties. They are, therefore, dyed in an apparatus with the addition of 10–20 % Glauber's salt and 3 % sulphuric acid; the material is entered at 128° F. or more. After boiling for an hour, 2—3 % bichrome are added and boiling continued for another ¾ hour. Mordant Yellow O is used for shading off towards yellow and Fast Mordant Blue towards blue. By means of suitable combinations of the above-named dye-

2,5 % **Dianil Fast Red PH**
0,375 % **Acid Alizarine Black SE powder**
0,5 % **Acid Alizarine Yellow RC**
10 % Glauber's salt, 5 % acetate of ammonia;
2,5 % acetic acid

2 % bichrome

stuffs with one another and with the shading off dyestuffs (small quantities of Patent Blue A or Fast Acid Violet A2R may also be used), all shades from currant to claret can be obtained.

The shades so produced satisfy in most cases all demands regarding fastness; only in very severe milling is it possible for shades chiefly produced with Acid Alizarine Red G or B to cause defects, if the goods are left too long unwashed in the milling liquid, for both these dyestuffs are liable under these unfavourable circumstances to bleed, or to lose in intensity.

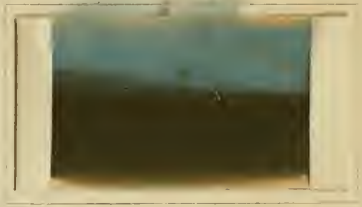
Where extreme demands as to fastness to bleeding are made, it is necessary to use Dianil Fast Red PH which can be shaded off with Acid Alizarine Yellow RC towards yellow, with Fast Mordant Blue R or B or Acid Alizarine Black SE towards blue, and with Acid Alizarine Brown BB towards a duller brown. The dyebath is prepared with the solution of dyestuffs required, together with 5% acetate of ammonia; the goods are entered at 86—104° F., the temperature being raised not too quickly to the boil, and after boiling for $^{1}/_{2}$ hour 2—5% acetic acid are slowly added by means of a dripping funnel. When the bath is exhausted, the shade is developed with 2—3% bichrome and boiling still continued for $^{3}/_{4}$ hour.

By means of this combination red shades are obtained which are extremely fast to milling, and which also satisfy all demands as regards fastness to light and wearing.

Drab.

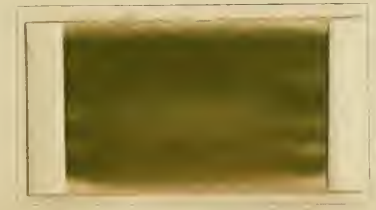
As was the case in loose wool dyeing, so in slubbing dyeing also, the fastest drab shades are obtained on an Indigo ground.

Upon **Indigo Gronnd:**
0,14% **Acid Alizarine Grey G**
0,1% **Alizarine Red 1WS powder**
0,07% **Alizarine Yellow GGW powder**
10% Glauber's salt, 5% acetic acid
0,25% bichrome, 0,5% lactic acid.



The grounding with Indigo is done in an apparatus by means of the hydrosulphite vat free from sediment. The working methods to be observed have already been described in detail on page 26. The Indigo shades thus obtained upon slubbing are well dyed through, do not rub, and offer an even and solid foundation for topping.

For that purpose it is above all necessary to use well equalising and, at the same time, fast chrome developing dyestuffs, because any unevenness becomes much more apparent in the lighter drabs than in the dark shades described in the foregoing chapters. It is, moreover, advisable to choose dyestuffs which dye, and are developed, in an acetic acid bath, and which do not require too much chrome, as otherwise a partial destruction of the Indigo ground, by oxidation, may easily take place. To the chrome bath is also added lactic acid, the presence of which exercises a favourable influence on the preservation of the Indigo ground.



2% bichrome, 2% tartar
0.4% **Alizarine Brown paste**
0,2% **Alizarine Yellow GGW powder**
0,2% **Alizarine Blue DNW paste**
1% ammonia; 2×2,5% acetic acid.

In the first place the following are suitable for the production of drab shades upon slubbing grounded with Indigo: **Fast Mordant Blue** R, B, **Alizarine Red** 1WS, **Alizarine Yellow** GGW, which are developed with fluoride of chrome, but still better with bichrome; besides, **Acid Alizarine Grey** G, **Acid Alizarine Brown** B, **Acid Alizarine Grenade** R, **Mordant Yellow** O, **Chromotrope** FB and F4B, **Acid Alizarine Blueblack** B and 3B, all of which must be developed with bichrome. To them may be added for shading off the fastest acid dyestuffs, such as Acid Rosamine A, Fast Acid Violet R, Acid Violet 5BF, Milling Blue 2R extra, and Patent Blue A.

Less fast to light, especially as far as the blue ingredient is concerned, are drab shades obtained upon bichrome-tartar mordant, by the combination of **Alizarine Blue** with **Alizarine Brown**, **Alizarine Red** 1WS and **Alizarine Yellow** GGW. These dyestuffs are worked at first in a bath containing some ammonia. The liquid is then gradually acidified after boiling for ½ hour, by slowly dropping acetic acid into it, with a view to a perfect fixation of the dyestuffs. The use of water free from lime and the further utilization of old dyebaths (as described in vol. I, page 139), facilitates the process considerably and ensures an even dyeing through of the slubbing. Anyhow, the penetration as well as the matching of shades is not an easy matter when dyeing light drabs; these are therefore nowadays almost exclusively produced with the chrome developing dyestuffs, which equalise better and can be more easily matched than Alizarine dyestuffs.

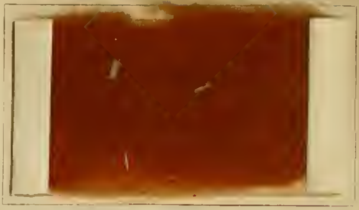
0,[illegible] % **Acid Alizarine Black SE powder**
0,45 % **Acid Alizarine Brown BB**
0,15 % **Mordant Yellow O**
10 % Glauber's salt, 5 % acetic acid; 2 % sulphuric acid
1 % bichrome

0,25 % **Acid Alizarine Grey G**
0,025 % **Fast Acid Violet R**
0,025 % **Patent Blue A**
10 % Glauber's salt, 3 % acetic acid; 2 % sulphuric acid
0,25 % bichrome.

Bluegrey to grey shades are dyed with **Acid Alizarine Black** SE or **Acid Alizarine Blue** WE which can be shaded off with Alizarine Direct Blue B, Acid Alizarine Brown BB or Acid Alizarine Red G and Mordant Yellow O. The water ought to be as free from lime as possible; the goods are boiled with the addition of 1–2 % oxalate of ammonia and 2 % ammonia, and after boiling for ½ hour acetic acid is slowly added and the shade developed, according to the required depth, with ½–1½ % bichrome. The shades are distinguished for their fastness to milling and light.

For lighter grey shades the combination of **Acid Alizarine Blueblack** B or 3B with **Acid Alizarine Brown** BB and **Mordant Yellow** O which equalises well, is to be recommended; in that case the material is initially dyed with the addition of 10 % Glauber's salt and 3 % acetic acid. When the bath is nearly exhausted and after a further addition of 2 % sulphuric acid, the shade is developed with ½–1 % bichrome. Delicate silver grey shades are dyed in the same manner by means of **Acid Alizarine Grey** G which can be shaded

0,3% **Acid Alizarine Brown BB**
0,16% **Mordant Yellow O**
0,21% **Acid Alizarine Red G**
10% Glauber's salt, 3% acetic acid; 2% sulphuric acid
0,5% bichrome.



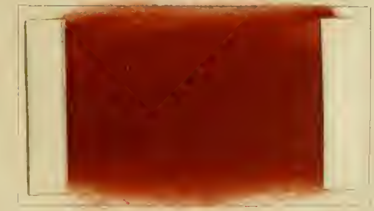
off with Acid Alizarine Red G and Mordant Yellow O, for clearer shades with Fast Acid Violet A2R and Patent Blue A.

For very light silver grey shades Fast Acid Blue R is an excellent dyestuff which can be employed in an acetic acid bath without after-treatment, and possesses very good fastness to milling and light.

The chief dyestuff for light brown and drab shades is Acid Alizarine Brown BB which may be shaded off with Alizarine Red 1WS or Acid Alizarine Red G and Mordant Yellow O.

Salmon and strawberry shades are obtained with Alizarine Red 1WS or Acid Alizarine Red G, shaded off with Mordant Yellow O and Acid Alizarine Grenade R or Acid Alizarine Violet N or also with Patent Blue A, whereas olive and mignonette shades are produced with Mordant Yellow O, shaded off with Fast Mordant Blue B or R, Acid Alizarine Blueblack 3B and Patent Blue A, on the one hand and with Alizarine Red 1WS or Acid Alizarine Red G on the other hand.

Owing to their solubility, their equalising property and good fastness to milling and light Fast Mordant Blue R and B yield an excellent foundation for every kind of drab shades.



0,01% **Patent Blue A**
0,45% **Alizarine Red 1WS powder**
0,1% **Mordant Yellow O**
10% Glauber's salt, 3% sulphuric acid
0,5% bichrome.

Combined with Mordant Yellow O for shading off towards yellow, with Acid Alizarine Red G and B or Alizarine Red 1WS, or Acid Alizarine Grenade R towards red, with Acid Alizarine Brown BB for darkening — to which may be added in small quantities Patent Blue A and Fast Acid Violet A2R — the most varied fast drab shades can be produced by means of Fast Mordant Blue, by dyeing them first in a sulphuric acid bath and developing with chrome.

0,5% **Fast Mordant Blue B**
0,05% **Mordant Yellow O**
0,1% **Acid Alizarine Red G**
10% Glauber's salt, 3% acetic acid; 2% sulphuric acid
0,5% bichrome.

Lastly, drab shades of very good fastness to milling, but not very fast to light, can be produced on slubbing material for cheaper articles, with Chromogene I, especially light browns and drabs which may be combined with Alizarine Red 1 WS and Mordant Yellow O, and also some Patent Blue A; likewise greys and olives, if shaded off with Fast Mordant Blue B, Mordant Yellow O and Patent Blue A.

White and Pearl.

White and pearl shades are in frequent request for mixing with other colours. They therefore play an important part in slubbing dyeing.

0,001% **Methyl Violet BB extra**
2,5% soap,
afterwards **sulphured.**

For their production the same methods are followed as for loose wool; but dry bleaching, being especially difficult to apply to slubbing, is seldom resorted to, and the "wet" methods are consequently preferred as being easily and safely carried out in an apparatus. Having already discussed in detail the production of these shades, it suffices to refer here to page 39 ff., in order to avoid unnecessary repetitions.

Another method may however be mentioned as particularly adapted for bleaching slubbing. The apparatus used for the same consists of a vessel capable of being hermetically closed and lined inside with lead; it is connected with an air pump and a cylinder containing liquid sulphurous acid, and contains a pressure gauge and a waste tap; on the bottom is placed a small vessel with water. The latter is heated before the commencement of the bleaching process to 140—158° F., and supplies the necessary moisture by evaporating the water in the vacuum. The material is previously evenly wetted with soap in a special apparatus, some Methyl Violet or Crystal Violet O being added. It is then hydroextracted and brought into the vessel without being rinsed; the latter is then closed and the vacuum pump set in motion. After a short time the pump is stopped, and sulphurous acid allowed to enter the vessel till the pressure is reduced to O. After about 6 hours the sulphurous acid is drawn off, the apparatus opened and the bleached slubbing dried.

This method of vacuum bleaching is especially well adapted to tops the quality of which is not injured by it. The strength of the bleach is controlled by the pressure of the vacuum i. e., the more or less completely the air is emptied out of the vessel before the admission of the sulphurous acid.

Effect Shades.

Bright effect shades, such as blue, red, yellow, green etc. are in great demand in the manufacture of mens suitings intended for heavy milling.

The slubbing is dyed in the manner as described on pages 57 and 58 for decorative colours on loose wool.

It goes without saying that in dyeing these shades on slubbing the fastness to the finishing processes of the goods must be taken in consideration, and that great precautions must be adopted in order to obviate faulty results, since these effect shades are, generally speaking, of rather looser character.

2. The Dyeing of slubbing for light milling.

The field of employing slubbing for the manufacture of ladies' material is a very big one, and consequently a great quantity is dyed nowadays for this purpose.

The fastness properties of colours used for ladies' goods are distinctly inferior to those used for gentlemen's suitings, for ladies' cloths have not to stand so much wear and tear and are less exposed to climatic changes and influences. Moreover, owing to the rapid change of fashion, these cloths are woven in a looser way, viz: they need not last quite so long as men's goods. Consequently, no severe requirements as to milling are made, as the firmness of the material is not such an essential point.

Ladies' cloths have to stand milling in weak soap or water and they need not be decatised very energetically; also no fastness to potting is required. Alkaline reactions are seldom experienced in the finishing processes, consequently a considerable number of dyestuffs are suitable which could not be used for gentlemen's suitings because they would not withstand the necessary operations and would either lose depth or change their shade.

On the other hand, the colours suitable for ladies' goods are far more brilliant; the shades more varied; the colour compositions brighter and more many-sided than those for gentlemen's wear, although it must be admitted that in recent years the colour variations and contrasts in men's suitings have been considerably increased.

On account of the great variety of shades asked for in the manufacture of ladies' cloths, the dyer has, on his part, to look round for colours which enable him to meet these varied requirements: he will use methods and dyewares which permit of a quick and certain matching and dyeing of shade.

Simpler dyeing methods, dyeing in an acid bath or dyeing with chrome developing colours, are therefore generally preferred to dyeing on a mordant or to combining Indigo with other colours because they enable dyers to dye to pattern much more readily and quickly.

The requirements which are made upon the fastness of the colours on slubbing material, which is used for ladies' cloths, are: fastness to water, fastness to stoving, fair fastness to light, fastness to perspiration and resistance to alkalies, especially ammonia and street dirt etc.

In order to dye easily and accurately, it is also necessary that the colours are readily soluble so that the employment of mechanical appliances is possible; also that they equalise fairly well. Slight unevennesses in the dyed slubbing are counter-balanced by the ginning, melanging, spinning and weaving, so that the requirements as to equalising are not very high. The number of colours which answer these requirements is a very considerable one, and consequently one and the same shade can often be produced in various ways sufficiently fast. Of course, generally speaking, the faster dyestuffs and faster combinations ought to be preferred in case there is a choice open between several colours or colour combinations, since the cost of production of the faster colour is scarcely, or very little higher than that of the colours of inferior fastness. Moreover, the difference of price is very minute in comparison to the value of the goods; and finally the pieces manufactured from slubbing are generally of a better quality, and the colours consequently required to be more durable.

We shall briefly discuss in the following chapters, the production of the principal shades, in a similar manner to what we have said in former chapters about the various colour combinations. It is of course impossible to include in this work a description of all the shades which are used in the manufacture of ladies' cloths.

Black.

Next to Acid Alizarine Black SE and SN, must be mentioned, for the production of Black shades on slubbing, which is intended for ladies' cloths, in the first place: Acid Alizarine Black R and the brands 3B, 3B extra, RH, RG, AC, T and TG; all these brands are very fast to light; very fast to alkali and to wearing. They equalise well; are readily soluble and can be used in mechanical machines.

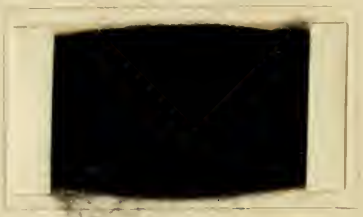
4.5 % **Acid Alizarine Black 3B**
10 % Glauber's salt, 2 + 2 % sulphuric acid
2 % bichrome.

The dyebath contains: 10 % Glauber's Salt and 4 % Sulphuric Acid, but it is advisable to use only half of the latter when starting the dyeing operation at 140–176° F. The bath is then heated to the boil, the second half of the acid added, and the goods boiled for 1 hour. Then 1–2 % of Bichrome are added, and the shade developed by boiling for 20 minutes. In order to counteract the injurious effect of the metal it is necessary to add to bright copper vessels, ½ % of Sulpho-Cyanide of Ammonia.

Acid Alizarine Black R and the kindred brands can be combined and shaded off with all chrome developing and fast acid dyestuffs.

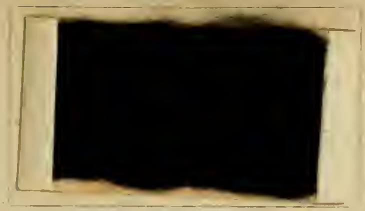
Jet Blacks are obtained with Acid Alizarine Black RG, T and TG, which are shaded according to requirements with Acid Alizarine Brown BB and Mordant Yellow O; for medium black shades, Acid Alizarine Black R is specially to be recommended (which, on account of its violet, bloomy overhand appearance resembles Logwood Black) also the brand RH and the slightly greener brand AC.

4 % **Acid Alizarine Black R**
1.25 % **Chromotrope Blue WB**
0,15 % **Mordant Yellow O**
10 % Glauber's salt, 3 % sulphuric acid
2 % bichrome, 1 % sulphuric acid.



Blue Black shades are obtained with Acid Alizarine Black 3B and 3B extra; in order to shade these towards blue, they must be combined with Fast Mordant Blue R, B, Chromotrope DW, F4B, FB, Chromotrope Blue WB, WG and A. If these colours, with the exception of the Fast Mordant Blue, are used in rather large quantities, it is advisable to add 1 % of Lactic Acid and 1 % of Sulphuric Acid in developing with Bichrome. Specially bloomy and bright blue blacks are produced with Acid Alizarine Black R, 3B and 3B extra if they are combined with Patent Blue A, Milling Blue 2R extra, Acid Violet 5BF and Fast Acid Violet A2R. All these fast acid dyestuffs can be added to the developing bath for shading purposes. The Acid Alizarine Blacks withstand milling such as is suitable for ladies' cloths extremely well. They are not at all affected by alkali and street dirt. Their fastness to perspiration, stoving,

4,5 % **Chromotrope S**
10 % Glauber's salt, 3 % sulphuric acid
3 % bichrome, 3 % lactic acid, 1 % sulphuric acid.



7% **Carbon Black BD**
0,25% **Scarlet B extra**
10% Glauber's salt, 3% acetic acid; 2% sulphuric acid

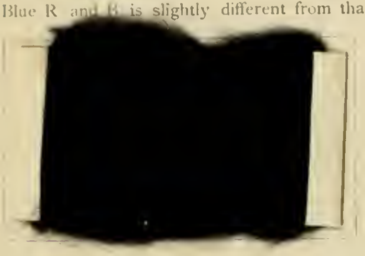
light, steaming etc. makes these colours extremely suitable for dyeing slubbing which is to be manufactured into ladies' cloths. Another beautiful and fast foundation for black on slubbing is obtained with Chromotrope S, SB and SR, which also fully answer all requirements that are made upon the fastness of the colours for ladies' cloths. Chromotrope S is dyed with the addition of 20% Glauber's Salt and 3% Sulphuric Acid. The dyeing operation is started at about 104—140° F; the bath is then heated to the boil, boiled for 1 hour, then 3% Bichrome, 3% Lactic Acid and 1% Sulphuric Acid added, and the shade developed by boiling for another 3/4 hour. For shading, Chrome Brown RO, Mordant Yellow O, Fast Mordant Blue R, B, Chromotrope DW, FB and F4B; and for finally matching to shade, smaller quantities of Patent Blue A, Milling Blue 2R extra and Fast Acid Violet A2R or R, are suitable.

In order to obtain blacks which are very fast to milling next to white wool and cotton, and show a sufficient fastness to alkali and stoving, and also to light (for ladies' cloths) Chrome Black B, T and 2G are used. The bath is prepared with the necessary amounts off dyestuff, 20% of Glauber's Salt and 3% Acetic Acid; the material is entered at a medium temperature, and the bath heated to the boil. After boiling 1/2 hour, 2% of Sulphuric Acid are added, boiling continued for another 1/4 hour, and the shade then developed by boiling for 1/2 hour with 2% Bichrome and 2% Copper Sulphate. These blacks are shaded best with Mordant Yellow O, Patent Blue A and Fast Acid Violet A2R. Cheap Blacks which need not show any particular fastness to milling and wearing, are obtained with Carbon Black 3B, B, BD and T, shaded with Patent Blue A, Flavazine T, Orange, Scarlet and Victoria Scarlet. Carbon Blacks are dyed with 10% Glauber's Salt and 3% Acetic Acid, to which is added after boiling for 1/2 hour, 2% of Sulphuric Acid. Although the fastness to light, acid, alkali, perspiration etc. of these Blacks is satisfactory for most purposes as regards the manufacture of ladies' cloth, still, the fastness to water and milling, also to stoving and steaming is considerably inferior to that of the chrome developing colours, so that they ought only to be resorted to if cheapness is the first consideration, and no great demand is made as to fastness.

Blue.

Blue shades suitable for light milling are of great importance in slubbing dyeing. Full ranges from dark Black-Blue to the lightest Sky-Blue are asked for, so that it seems advisable to discuss the production of blue shades at some length. Although, as was said before, for special reasons Indigo is not often employed, still in all cases where fastness is the predominant feature, Indigo must be used for the production of blue shades, either along with, or as a bottom for other colours. Indigo shades fast to rubbing are dyed evenly, expeditiously and surely by means of our Hydrosulphite Vat in a mechanical appliance, as was already described in former chapters (page 26 and 94). Considering the shortness of the dyeing operation, together with its great yield and its simple application, the employment of Indigo can be highly recommended. The cost of Indigo shades in comparison with other colour combinations, is slightly higher, but calculated on the value of better qualities of material, represents only a very small increase, and therefore is seldom to be seriously objected to for better materials. In many cases it is the novelty which deters the dyer from employing the Hydrosulphite vat, although the latter cannot be compared in any way with the difficulties which the capricious fermentation vat often presents. The application of Indigo on mechanical apparatus is described on page 28, so that we may now turn to the discussion of other colour combinations.

The full deep blue, the so-called "Navy" is the most important blue shade. It is produced in a most satisfactory manner with chrome developing colours, of which Fast Mordant Blue R, B, Chromotrope FB, F4B, DW, Chromotrope Blue A, WB and WG are the principal representatives; without exception readily soluble, they may be used in machine dyeing without any difficulty. Furthermore, they are very fast to milling and satisfy all requirements of the market; they are fast to alkali, perspiration and acid; very fast to light, rubbing, stoving; and finally they are scarcely, or very little changed by decatising. The dyeing method of Fast Mordant Blue R and B is slightly different from that of the other colours. The latter are dyed with the addition of 10 % of Glauber's Salt and 3 % of Sulphuric Acid; the material is entered at 122—140° F; the liquid heated to the boil and boiling continued for 1 hour, then the colour is developed with 3 % of Bichrome, 3 % Lactic Acid and 1 % of Sulphuric Acid by boiling for ¾—1 hour. Fast Mordant Blue R and B are dyed initially with the same ingredients, but they are developed with 1½—2½ % Bichrome without the addition of Lactic Acid and Sulphuric Acid. Contrary to the other developed blues, Fast Mordant Blue may be dyed on a chrome mordant. In this case the dyeing operation is carried out with the addition of Acetic Acid and finished with the addition of ¼—½ % of Bichrome (boiled 20 minutes).



5 % **Fast Mordant Blue B**
1.5 % **Milling Blue 2R extra**
0,38 % **Acid Alizarine Violet N**
10 % Glauber's salt, 3 % acetic acid; 2 % sulphuric acid
2 % bichrome

2.9 % **Chromotrope F4B**
0.8 % **Patent Blue A**
0.1 % **Acid Alizarine Black R**
10 % Glauber's salt, 3 % sulphuric acid
2 % bichrome, 2 % lactic acid, 1 % sulphuric acid.

For shading blue dyestuffs the following may be used: — Mordant Yellow O, Alizarine Yellow GGW, Alizarine Red 1WS, Acid Alizarine Red G and B, Acid Alizarine Grenade R, Acid Alizarine Violet and Alizarine Direct Blue B. In most cases the faster acid dyestuffs — Patent Blue A, Milling Blue 2R extra, Acid Violet 5BF, Fast Acid Violet A2R and R, also Flavazine T and S, are suitable for shading, and these, moreover, may be used in the chrome bath, which cannot be said of the above-mentioned chrome developing colours.

The Chromotropes, Chromotrope Blues and Fast Mordant Blue are affected by metals, and therefore they must not be dyed in bright dye-vessels; the addition of 3 ozs. of Sulpho-Cyanide of Ammonia to every 200 gallons of dyeliquid will counter-balance this defect.

Acid Alizarine Blue BB is of great importance in slubbing dyeing, for it is easily soluble and equalizes well; it is dyed with Glauber's Salt and Sulphuric Acid, and finally developed with Fluoride of Chrome.

For shading before chroming, Alizarine Red 1WS and Alizarine Yellow GGW are used; whilst Patent Blue A, Fast Acid Violet R and Flavazine S are suitable shading colours after developing with chrome. The shades are very fast to water and bleeding, and since the manufactured goods have not to stand a very severe milling, the want of fastness to alkali of the Acid Alizarine Blue BB shades need not be reckoned with. Copper in the presence of Fluoride of Chrome affects the shade considerably and obviates the lake formation; therefore it is necessary to add Sulpho-Cyanide of Ammonia to the bath whenever bright copper appliances are used for dyeing.

Alizarine Direct Blue B, which, similar to Acid Alizarine Blue BB, is to be considered a true Alizarine dyestuff, is especially suitable for the production of brighter and lighter blue shades. It does not equalize quite as well as Acid Alizarine Blue BB, so that it is necessary to start dyeing with the addition of Glauber's Salt and a very little Acetic Acid, and to add gradually some more Acetic or Sulphuric Acid in order to exhaust the dyestuff finally. In cases where great fastness to water and milling is required, the shades are after-treated with Bichrome; but for most purposes the acid dyed shade will be sufficiently fast to bleeding. Alizarine Direct Blue B is very fast to rubbing, alkali and light, and therefore, on account of its simple application, is a colour to be highly recommended for the dyeing of slubbing; it is shaded either with chrome developing colours or with fast acid dyestuffs such as Patent Blue A, Fast Acid Violet, Milling Blue, also Alizarine Direct Green G. For matching the shades finally, the latter dyestuffs in conjunction with Flavazine T and S are to be recommended.

2,25 % **Acid Alizarine Blue BB**
0,5 % **Alizarine Red 1 WS powder**
0,1 % **Alizarine Yellow GGW powder**
20 % Glauber's salt, 4 % sulphuric acid
4 % Fluoride of chrome.

3 % **Alizarine Direct Blue B**
0,25 % **Alizarine Red 1 WS powder**
20 % Glauber's salt, 2 % acetic acid; 2 % sulphuric acid
2,5 % bichrome.

By combining suitable acid dyestuffs, navy shades of highly satisfactory fastness can be obtained, especially by the simultaneous application of Milling Blue 2R extra, Patent Blue A, Fast Acid Violet and Flavazine T: if these shades are aftertreated with Fluoride of Chrome or Chrome Alum, their fastness to milling is considerably enhanced.

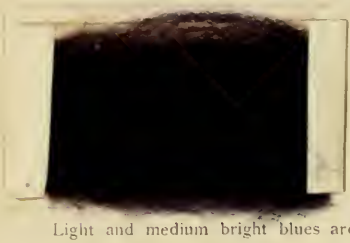
2 % **Milling Blue 2R extra**
1 % **Patent Blue A**
0,4 % **Mordant Yellow O**
10 % Glauber's salt, 4 % sulphuric acid
3 % Fluoride of chrome.

A cheaper navy blue is obtained by combining Victoria Violet 4BS with Patent Blue A in an acid bath.

Very cheap navy blues are obtainable by combinations of Victoria Violet 4BS and Naphtalene Blue B, Indigo Substitute B, V extra and WE, with slight additions of Flavazine T for darkening purposes.

Fast Dark Blue B extra together with Patent Blue A or Milling Blue 2R extra are fairly fast to water. The last named combination is dyed with the addition of 10 % of Glauber's Salt and 3 % of Acetic Acid, and the dyebath exhausted with 2 % of Sulphuric Acid.

All the other combinations, on the other hand, are dyed direct with 10—20 % Glauber's salt and 4 % Sulphuric Acid. This straightforward and quick application simplifies dyeing to shade and leaves the material unimpaired. The fastness to water, however, of very full, deep shades is not perfect, especially if the goods are to be milled in warm water. It is therefore advisable when dyeing slubbing with acid dyestuffs to exercise care, especially where the dyer has not full control of the further processes which the material has to go through; in that case, deep shades of navy blue are best dyed with chrome developing colours. The slightly increased price counterbalances the risk which the employment of acid dyestuffs entails.

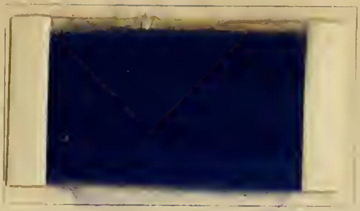


2,5 % **Victoria Violet 4BS**
1,15 % **Naphtaline Blue B**
0.25 % **Flavazine T**
20 % Glauber's salt, 4 % sulphuric acid

Light and medium bright blues are dyed on slubbing for ladies' material with combinations of the fast acid dyestuffs; especially suitable are Milling Blue 2R extra, Fast Acid Blue R together with Patent Blue A, Acid Violet 5BF and Fast Acid Violet R and A2R: they are dyed with the addition of 10 % Glauber's Salt and 4 % Sulphuric Acid, and fixed with 10 % of Chrome Alum, which latter ingredient yields shades fairly fast to water and milling. In order to increase the certainty as to fastness properties, Chromotrope Blue A, WB and WG or Fast Mordant Blue B and R in conjunction with the above mentioned acid colours are to be recommended. Furthermore, a combination of Acid Alizarine Grey G, Patent Blue A and Fast Acid Violet yields very fast shades; it is dyed with 10 % of Glauber's Salt and 3 % Acetic Acid, then 2 % Sulphuric Acid are added and the blue developed with 1 % of Bichrome. The medium blues thus obtained, are fast to milling and fairly fast to light.

3 % **Fast Dark Blue B extra**
.5 % **Milling Blue 2R extra**
20 % Glauber's salt, 3 % acetic acid; 2 % sulphuric acid.

Light Blues are dyed with Alkaline Blue, according to the method described in Volume I, page 123. Since the dyeing in two baths, viz: dyeing in an alkaline bath and developing in an acid bath entails difficulties in mechanical apparatus, it is more advisable to use simpler dyeing methods in slubbing dyeing. Frequently Victoria Blue is used, which is dyed with 10 % Glauber's Salt and 5 % Acetic Acid. The shades obtained with this colour are satisfactorily fast to milling for most purposes.



0,23% **Acid Alizarine Grey G**
0,4% **Acid Violet 5BF**
0,3% **Patent Blue A**
10% Glauber's salt, 5% acetic acid; 5% Chromalum
2% sulphuric acid.

The fastness to light of Victoria Blue is rather inferior to that of Alkaline Blue, and for better qualities of material a combination of Patent Blue A and N with a bright Acid Violet, such as Fast Acid Violet 5BF or 6BN is more advantageous. These are dyed in a Sulphuric Acid bath and aftertreated with 2% of Fluoride of Chrome, or some Chrome Alum is initially added to the dyebath; the shades thus obtained are enhanced as regards fastness to water, and leave little to be desired as regards general fastness. Since the fastness to light of the above mentioned combination of Patent Blue and Acid Violet is not inferior to that of the Alkaline Blues, the only drawback is that the shades are not quite so pure, which defect however is amply counterbalanced by the simpler dyeing method; and moreover by the quality of the slubbing being better preserved.

0,8% **Victoria Blue B**
10% Glauber's salt, 5% acetic acid

Green and Olive.

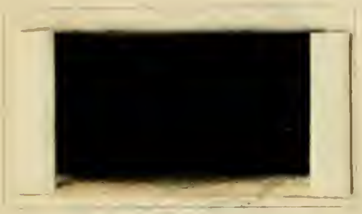
Green and Olive shades are dyed on slubbing which is to be milled in water only, in various ways, according to the requirements made upon their fastness. The fastest greens and olives (besides those obtained on Indigo bottom for the dyeing of which we refer to page 97) are obtained by chrome developing colours and by means of Alizarine Direct Green G.

In the first place we should mention Fast Mordant Blue B in conjunction with Mordant Yellow O and Patent Blue A. These colours are dyed in an acid bath and then developed with 1—2% of Bichrome, and yield deep green and olive shades which answer all requirements made upon the workability and wear of the so manufactured goods. When using copper apparatus 3 oz of Sulpho-Cyanide of Ammonia for every 200 gallons of dye liquid have to be added, viz: $^1/_2$ % of Sulpho-Cyanide of Ammonia referring to the weight of the slubbing.

0,5% **Acid Violet 5BF**
0,5% **Patent Blue A**
5% Chromalum, 10% Glauber's salt; 3% sulphuric acid

Also the green and olive shades obtained with Chromotrope S, FB, F4B, Chromotrope Blue A, WB and WG, Mordant Yellow O and Patent Blue A are very fast to milling and wearing. They are obtained in a similar way to those produced with Fast Mordant Blue, but for developing 2–3% of Bichrome, 1% Sulphuric Acid and 2–3% Lactic Acid are added.

For lighter green and olive shades the following may be used, in addition to the above mentioned combinations, Acid Alizarine Blue Black B, 3B or Acid Alizarine Grey G, together with Patent Blue A, Mordant Yellow O and Acid Alizarine Yellow GGW. These are shaded towards brown with Acid Alizarine Brown BB. The slubbing is dyed with the addition of 10% Glauber's Salt and 3% Acetic Acid. After boiling for ½ hour, 2% of Sulphuric Acid are added, and after a further ½ hour, when the bath is nearly exhausted, 2% of Bichrome are added, and the material boiled for another ½ hour.



2% **Fast Mordant Blue B**
0,6% **Mordant Yellow O**
0,65% **Patent Blue A**
10% Glauber's salt, 3% acetic acid: 2% sulphuric acid

2% bichrome.

Medium Olives can be obtained with Alizarine Red 1WS or Acid Alizarine Red B, Acid Alizarine Violet N, Patent Blue A and Mordant Yellow O. They are dyed in a Sulphuric Acid bath and developed with Bichrome.

1,75% **Acid Alizarine Grey G**
0,2% **Mordant Yellow O**
0,6% **Patent Blue A**
10% Glauber's salt, 5% acetic acid; 2% sulphuric acid

2% bichrome.

Brighter and purer green shades, of great fastness, are obtained with Alizarine Direct Green G, which is distinguished for its great fastness to alkali and water, and also for its excellent fastness to light. It can be dyed on a chrome mordant; but on account of the simpler application and greater preservation of the material, the after-chroming method is used almost exclusively; sometimes even the direct acid dyed shade will suffice as regards fastness to bleeding. In both cases attention must be paid to the equalizing. The bath is prepared with 10% Glauber's Salt and 2–3% Acetic Acid or 3–5% Acetate of Ammonia; the liquid slowly raised to the boil and the dyestuff exhausted by gradually adding some more Acetic Acid and Sulphuric Acid. The after-treatment with Bichrome is carried out in the usual manner. For shading, chrome developing colours or chrome resisting acid colours may be used, such as Alizarine Direct Blue B, Fast Mordant Blue B, Acid Alizarine Red G, Mordant Yellow O, Patent Blue A, Fast Acid Violet A2R and Flavazine T on the one hand; or Alizarine Direct Blue B, Patent Blue A, Fast Acid Violet, Milling Blue, Flavazine T etc. on the other. In all cases the dyeing to shade is brought about by these equalizing dyestuffs.

The pure shade of Acid Alizarine Green G, its fastness to alkali, acid and milling, also its excellent fastness to light, will recommend its application on slubbing, in all those cases where fastness to wearing is essential, and grounding with Indigo for certain reasons not to be resorted to.

The sum total of the fastness properties of shades obtained with Alizarine Direct Green G is very little inferior to those obtained on an Indigo bottom, and is to be considered equal to greens obtained with Fast Mordant Blue B and Fast Yellow.

Very bright green and olive shades are obtained with Patent Blue A and Milling Yellow O. The latter colour does not equalize well and it is therefore necessary to begin with 20% Glauber's Salt and 5% Acetic Acid and to exhaust the dyestuff by adding 2% Sulphuric Acid. An after-treatment with 2—3% Fluoride of Chrome increases the fastness to milling, so that the shades then suffice for very severe requirements. In most cases, however, the addition of Fluoride of Chrome may be dispensed with: if the shades are less pure, Acid Alizarine Grey G can be added, or instead of Milling Yellow O, our Mordant Yellow O which equalizes better, may be used. Shades so produced are after-treated with Fluoride of Chrome or Bichrome.

0,9% **Acid Alizarine Blue Black B**
0,6% **Acid Alizarine Brown BB**
1,45% **Mordant Yellow O**
10% Glauber's salt, 5% acetic acid; 2% sulphuric acid
1,5% bichrome.

Combinations of Patent Blue A and Flavazine T yield very bright shades. Contrary to Milling Yellow O, these colours can be dyed in a Sulphuric Acid bath, viz: with 20% Glauber's Salt and 4% Sulphuric Acid. In order to increase the fastness, an after-treatment with Fluoride of Chrome is advantageous.

For darkening the last named combination, Fast Acid Violet A2R and Milling Blue 2R extra, are suitable.

Cheaper green and olive shades of rather inferior fastness are obtained with Naphtalene Green V, and still cheaper ones with Fast Acid Green BB, together with Flavazine T and Victoria Yellow concentrated, and Naphtalene Blue B and Azo Acid Carmine B. The fastness to bleeding of these colours, especially in deep shades, is not very satisfactory however, and therefore these combinations ought only to be used for cheap goods.

1,1% **Mordant Yellow O**
0,1% **Acid Alizarine Grey G**
0,5% **Patent Blue A**
10% Glauber's salt, 4% sulphuric acid
2% bichrome.

Brown.

Deep brown shades on slubbing, intended for milling in water only, are best obtained with our Acid Alizarine Browns as a foundation. These colours answer extremely well all the requirements which may be made during the further manufacture of the goods, and in wearing.

Acid Alizarine Brown R, B, BB and T are readily soluble and equalize well; they may therefore be used unhesitatingly. They are dyed with 10% Glauber's Salt and 3% Sulphuric Acid. The slubbing is entered at 140° F; the bath heated to the boil, boiled for 1 hour, and

0,75 % **Patent Blue A**
0,375 % **Flavazine T**
20 % Glauber's salt, 4 % sulphuric acid
1 % Fluoride of chrome.

the shade developed with 1½—2½% of Bichrome (½–¾ hour at the boil). In order to obtain the various shades of Brown, the above mentioned colours are shaded with Mordant Yellow O towards yellow; Acid Alizarine Red G, B, Alizarine Red 1WS and Acid Alizarine Grenade R towards red; Fast Mordant Blue R, B, Chromotrope DW, F4B and FB, Acid Alizarine Grey G and Acid Alizarine Blue Black B, 3B, Acid Alizarine Black R and 3B towards olive. After chroming they are shaded with Patent Blue A, Fast Acid Violet R and Flavazine T.

2,3 % **Acid Alizarine Brown T**
0,6 % **Acid Alizarine Blue Black B**
1,5 % **Mordant Yellow O**
10 % Glauber's salt, 5 % acetic acid, 2 % sulphuric acid
3 % bichrome.

Likewise Chrome Brown RO is to be recommended for the production of deep brown shades. This is combined with Alizarine Red 1WS, Mordant Yellow O, and finished with Patent Blue A; it is dyed with 10% Glauber's Salt and 3% Sulphuric Acid, and developed, after boiling for 1 hour, with 2—3% Bichrome, 1% Sulphuric Acid and 2—3% Lactic Acid. If the browns are to be shaded towards olive, Chromotrope FB and F4B or Acid Alizarine Grey G, Acid Alizarine Blue Black B and 3B are employed. The dyeing process is carried out as described above, with the only difference that when using the two last mentioned colours, the material is boiled initially with 3% Acetic Acid and then the bath is exhausted after ½ hour, with 2% Sulphuric Acid.

2,5 % **Acid Alizarine Brown BB**
0,9 % **Acid Alizarine Red G**
0,5 % **Mordant Yellow O**
10 % Glauber's salt, 4 % sulphuric acid
2,5 % bichrome.

Deep browns and current olive browns are obtained in a simple manner and very fast, by combining Fast Mordant Blue R or B, or Acid Alizarine Black R, Mordant Yellow O with Acid Alizarine Red G, or sometimes also with Acid Alizarine Brown BB. These colours are used in a Sulphuric Acid bath and developed with Bichrome; they require however less Chrome for developing than Chrome Brown RO.

2% **Chrome Brown RO**
1,6% **Mordant Yellow O**
0,25% **Alizarine Red 1WS powder**
0,1% **Patent Blue A**
10% Glauber's salt, 1,5% sulphuric acid, 1,5% sulphuric acid
2,5% bichrome, 1% sulphuric acid, 2,5% lactic acid

Light browns and bronze shades are obtained in a similar manner to the deep browns, with Acid Alizarine Brown; also Chromogen I in conjunction with Patent Blue A, Fast Acid Violet A2R or R, Alizarine Red 1WS and Mordant Yellow O, or Alizarine Yellow GGW are used for this purpose. These combinations are specially suitable for light shades, since Chromogen equalizes extremely well; its fastness to light however is rather inferior to that of Acid Alizarine Brown; still it will suffice for nearly all purposes. In order to utilize the colour and fix it thoroughly, it is necessary to develop Chromogen with Bichrome, the quantity of which depends upon the amount of Chromogen used; for 3% of Chromogen I, 3% of Bichrome are required; and for 10% of Chromogen, 6% of Bichrome are necessary. Furthermore, in deep shades, the amount of Sulphuric Acid will have to be increased.

Deep brown shades of rather inferior fastness to water and light than those mentioned hitherto, are obtained with Acid dyestuffs: Fast Acid Violet A2R and Azo Acid Carmine B are used as red; Patent Blue A, Fast Acid Green BB and Naphtalene Green V as blue; Milling Yellow O, Orange G, Brilliant Orange G and Flavazine T as yellow ingredients. However, the employment of these combinations is not to be recommended, since the fastness of the shades leave much to be desired: only in case the dyer has the further manufacture and the finishing of the manufactured goods under his control, may he apply these colours in order to cheapen his production. Generally speaking however, the difference of price of these combinations and that of Acid Alizarine Brown is so slight that it is not worth while to run the risk of complaints by using the colours of inferior fastness.

1,3% **Acid Alizarine Red G**
0,9% **Acid Alizarine Black R**
1,75% **Mordant Yellow O**
10% Glauber's salt, 4% sulphuric acid
2,5% bichrome.

Currant, Claret and Violet.

These shades are best obtained on slubbing which is to be manufactured into ladies' goods, with chrome developing colours: Acid Alizarine Violet N, Acid Alizarine Grenade R, Alizarine Red 1WS, 3WS, and Acid Alizarine Red B and G. These are combined with; Mordant Yellow O, Acid Alizarine Black R, Fast Mordant Blue R, B, Patent Blue A, Fast Acid Violet R and Acid Violet 5BF.

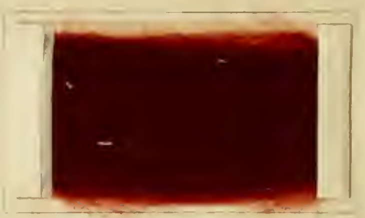
The colours are dyed with 10% Glauber's Salt and 3—4% Sulphuric Acid, and developed with 2—3% of Bichrome. They are readily soluble and therefore suitable for machine dyeing; and they equalize well. The shades obtained are fast to milling, light and alkali, and their cost of production is small.

6 % **Chromogen I**
0,5 % **Mordant Yellow O**
10 % Glauber's salt, 4 % sulphuric acid
4 % bichrome.

Cloth Red O also, when used according to the chrome developing method and shaded with Patent Blue A, Acid Alizarine Red G and Mordant Yellow O, yields claret shades which are very fast to milling and comparatively cheap.

Shades obtained in a Sulphuric Acid bath with Brilliant Crimson, Naphtol Red and Victoria Rubine O, which are combined with Flavazine T, Patent Blue A, Chromotrope 6B and Azo Acid Carmine B, are still cheaper, although less fast. Great care must be exercised in milling when using these colours, in order to avoid bleeding into white; moreover, these combinations are not fast to stoving.

2 % **Acid Alizarine Red G**
1,75 % **Acid Alizarine Grenade R**
1 % **Mordant Yellow O**
10 % Glauber's salt, 4 % sulphuric acid
3 % bichrome.

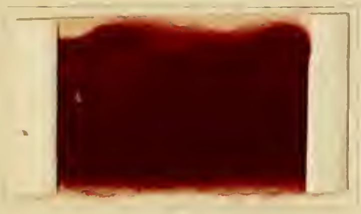


By using Fast Acid Violet, Fast Acid Blue and Acid Rosamine, together with Flavazine T, Oxydianil Yellow O and G, Patent Blue A and Acid Alizarine Grey G, faster claret and currant shades are obtained; especially when aftertreated with Fluoride of Chrome the fastness to bleeding and fastness to light is enhanced, although this naturally increases the cost of production.

For bright and light violets the above mentioned fast acid colours form an excellent foundation. Shades obtained with Fast Acid Violet R and A2R are easily shaded with Acid Violet 5BF, Milling Blue 2R extra and Patent Blue A. For light to medium effects the direct acid dyed shades will be found to be satisfactory. In order to increase the fastness an aftertreatment with 1—2% of Fluoride of Chrome or bichrome is resorted to.

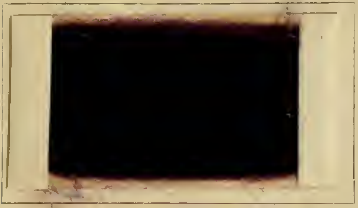
Red and Pink.

For the production of Red shades Acid Alizarine Red G and B, Dianil Fast Red PH and Alizarine Red 1WS can be employed.



3 % **Cloth Red O**
1 % **Acid Alizarine Red G**
0,13 % **Patent Blue A**
20 % Glauber's salt, 2 % sulphuric acid, 1 % sulphuric acid
1,5 % bichrome.

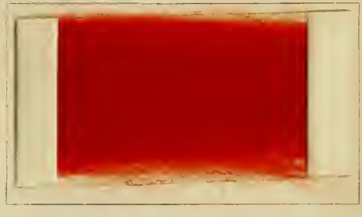
The application of Dianil Fast Red PH is rather different from that of the other colours owing to the fact that it sometimes equalises unsatisfactorily. The dyebath is prepared with 10 % Glauber's salt and 3 % Acetic acid, the slubbing entered at medium heat and the temperature then raised to the boil; after boiling for 1/2 hour, 2 % Sulphuric acid are gradually added, and after a further 1/2 hour, the shade developed with Bichrome or Fluoride of Chrome; of the former 1–2 % and of the latter 2–3 % are needed. For shading towards yellow, Milling Yellow O or Oxydianil Yellow O are used, and in order to produce bluer hues, either Scarlet B extra, Victoria Scarlet or Fast Acid Violet and Rosazeine can be employed; for rather duller shades, Mordant Yellow O, together with Acid Alizarine Red B and Alizarine Red 1 WS are suitable. Reds obtained in this way are perfectly fast, and their production simple and certain.



1,6 % Fast Acid Violet R
0,9 % Milling Blue 2 R extra
10 % Glauber's salt, 4 % sulphuric acid
1,5 % bichrome.

The application of Alizarine Red 1 WS — the alumina lake of which produces very bright shades — requires rather greater care. The bath is prepared with 10 % Glauber's salt and at most, 3 % sulphuric acid; the shade is developed by adding 10 % of Alum to this bath, or, better still, in a second bath prepared with 10 % of Alum and 1 % Oxalic Acid. The two bath method is more convenient since the lake formation in the dyebath is avoided, which often gives rise to a great many flaws in the result, viz: insufficient penetration and rubbing shades. Both baths can be used for further lots so that the cost of production is scarcely increased. In case the brilliancy of the resulting red is not satisfactory, it can be combined similarly to Dianil Fast Red PH, with Scarlet B extra, 3R, Victoria Scarlet 3R, Fast Acid Violet A 2R, R or small traces of Rosazeine O or B; for yellowing the shade Milling yellow O is used.

2 % Alizarine Red 1 WS powder
2,5 % Scarlet B extra
0,25 % Milling Yellow O
10 % Glauber's salt. 3 % sulphuric acid
10 % alum.



The application of Victoria Scarlet or Scarlet B extra as auxiliary dyestuffs for slubbing which is to be stoved, is not to be recommended on account of the sensitiveness of these colours to stoving. In that case Scarlet 3R, 4R etc. are used.

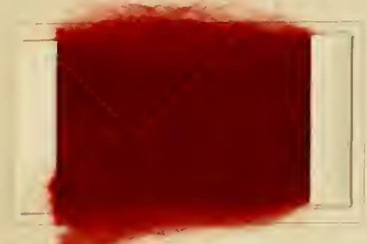
In order to obtain less brilliant, but fast reds, Acid Alizarine Red G or B are suitable foundation colours; they are dyed in a sulphuric acid bath and developed with bichrome. As auxiliary dyestuffs the following may be employed: Milling Yellow O, Oxydianil Yellow O, G, Mordant Yellow O, for yellowing; Milling Scarlet 4R conc., Alizarine Red 1 WS, Acid Alizarine Grenade R, Acid Alizarine Violet N, Scarlet B extra, Cloth Red O, Fast Acid Violet R and A 2R, and in small quantities, Rosazeine O and B for blueing the results. The above mentioned combinations are all obtained with developing colours as a foundation, and are in every way sufficiently fast to milling, light and wearing, for the production of ladies' goods. But it is also possible to dye red shades on slubbing satisfactorily fast, with several acid colours.

Salle

In the first place, Acid Rosamine A and Fast Acid Violet-R and A2R must be mentioned, which can be shaded with Flavazine T, Milling Yellow O and Milling Blue 2R extra; traces of Rosazeine may be used for brightening the shade.

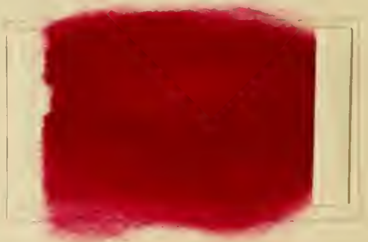
A red very fast to milling is obtained with Milling Scarlet 4R concentrated, either alone or in conjunction with Milling Yellow O and Fast Acid Violet R. It is dyed in an Acetic acid bath with a gradual addition of Sulphuric acid. The fastness to light and stoving of Milling Scarlet 4R however, is not quite so satisfactory as that of the combination of Fast Acid Violet and Acid Rosamine.

In this respect the combination of Brilliant Crimson O, Victoria Rubine O with Flavazine T are distinctly superior, but they are not as fast to water and milling. Reds obtained from Scarlets and Victoria Scarlets are fairly fast to light, but not sufficiently fast to stoving. Goods dyed with these colours with 10% Glauber's salt and 3% Sulphuric acid must be very carefully treated in milling, in order to avoid their bleeding into white or light tinted grounds.



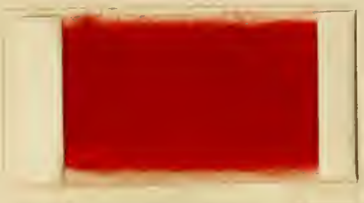
1,8% **Acid Alizarine Red G**
0,3% **Fast Acid Violet R**
10% Glauber's salt, 4% sulphuric acid
1,5% bichrome.

Pink shades are obtained with combinations of Rosazeine with Oxydianil Yellow O, G or Milling Yellow O. The bluer hues are produced with Fast Acid Violet R. In order to improve the evenness they are dyed in an acetic acid bath.



1% **Fast Acid Violet R**
0,25% **Rosazeine B**
0.5% **Milling Yellow O**
20% Glauber's salt, 3% acetic acid, 2% sulphuric acid.

Bright pinks are obtained as follows: The slubbing is dyed with the necessary amount of Rosazeine with the addition of 3% Soap for ½–1 hour at 122° F; the material is then hydroextracted and afterwards taken in the vacuum bleaching apparatus described on page 103, in which it is treated with gaseous sulphurous acid.

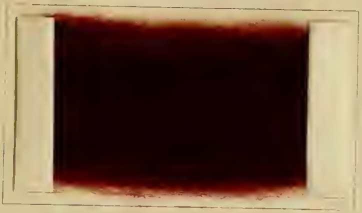


3,2% **Milling Scarlet 4RO**
1% **Milling Yellow O**
0,15% **Fast Acid Violet R**
10% Glauber's salt, 3% acetic acid, 3% acetic acid.

Better than Rosazeine are Fast Acid Magenta G, Fast Acid Phloxine A and Fast Acid Eosine G. These colours equalize exceedingly well, and may be dyed with Sulphuric acid. They are considerably faster to light than Rosazeine, and though not quite as fast to milling as the latter, their fastness to water and milling is generally satisfactory considering that only very little dyestuff is required for the production of pinks.

Orange and Yellow.

Orange and Yellow shades are sometimes asked for on slubbing, for ladies' goods. They are obtained with Alizarine Yellow GGW and RW in combination with Alizarine Red 1WS or Acid Alizarine Red G and Fast Acid Violet; these are dyed in an acid bath and developed afterwards with Bichrome.

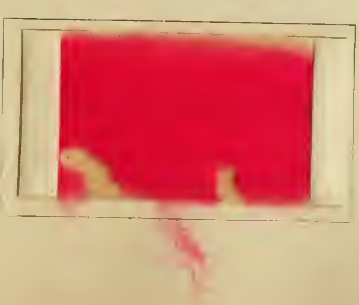


3,4 % **Victoria Rubine O**
0,12 % **Flavazine T**
0,06 % **Patent Blue A**
20 % Glauber's salt, 4 % sulphuric acid.

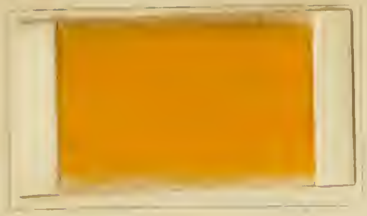
Much purer orange and yellow shades, however, are obtained by using Oxydianil Yellow O or G, or, still better, Milling Yellow O in combination with Milling Scarlet 4R conc. Shades obtained in this way are sufficiently fast to milling, and generally stand light and stoving satisfactorily.

0,05 % **Rosazeine B**
3 % soap
afterwards stoved.

In order to improve the fastness properties further, Milling Yellow O is used in combination with Acid Alizarine Red G, but the shades thus obtained are not quite so pure. In all cases where Milling Yellow O is employed, the dyeing operation is begun in an Acetic



1 % **Fast Acid Magenta G**
0,25 % **Fast Acid Eosine G**
10 % Glauber's salt, 3 % sulphuric acid.



2,5% **Milling Yellow O**
0,02% **Milling Scarlet 4RO**
20% Glauber's salt, 3% acetic acid, 3% acetic acid.

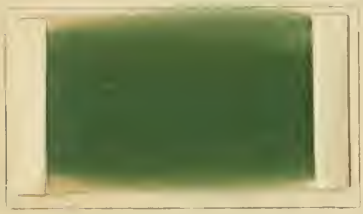
acid bath, the temperature gradually raised to the boil and the bath exhausted by adding Acetic acid, or when using Acid Alizarine Red G, by the addition of Sulphuric acid and developing with Bichrome.

Fancy Shades.

0,9% **Acid Alizarine Red G**
0,5% **Alizarine Yellow GGW powder**
0,15% **Fast Acid Violet R**
20% Glauber's salt, 5% acetic acid, 2% sulphuric acid
1% bichrome.

In selecting dyestuffs which are suitable for the production of fancy shades, great attention must be paid to the equalizing properties, whilst the fastness to bleeding need scarcely be taken into consideration at all, since so very little colour is used.

For yellowish and greenish shades, Alizarine Yellow GGW is to be recommended, which is shaded with Patent Blue A and Alizarine Red 1WS. Instead of the latter, Acid Alizarine Red G may be employed; also Alizarine Yellow GGW, Alizarine Red 1WS and Acid Alizarine Blue Black B and 3B and Acid Alizarine Grey G are suitable for producing even results of satisfactory fastness to milling and light. For darker shades Mordant Yellow is generally employed, which is shaded up with Acid Alizarine Black R and Acid Alizarine Red G or Alizarine Red 1WS, to pattern.



0,085% **Patent Blue A**
0,066% **Alizarine Red 1WS powder**
0,11% **Alizarine Yellow GGW powder**
10% Glauber's salt, 1,5% sulphuric acid
0,5% bichrome.

All these combinations are best dyed with 10% of Glauber's salt and 3% Acetic acid, and the baths exhausted with Acetic Acid instead of Sulphuric acid, which enhances their equalizing properties. According to depth of shade the colours are developed with $^1/_4$—$^3/_4$% of Bichrome.

Green fancy shades of rather inferior fastness are obtained with Flavazine T shaded with Patent Blue A, Acid Alizarine Grey G, Fast Acid Violet A2R or Fast Acid Magenta G.

Fast Blue fancy shades are produced with Acid Alizarine Blue Black 3B or B mixed with Mordant Yellow O or Alizarine Yellow GGW. With these colours range Fast Mordant Blue R and B, which are likewise shaded with Mordant Yellow O and Acid Alizarine Red G. Furthermore, mixture shades obtained with Acid Alizarine Grey G, Patent Blue A and Fast Acid Violet R, are very fast indeed. In all cases it is advisable to dye in an Acetic acid bath; to exhaust the bath by adding a little Sulphuric acid and to develop the shades with $^1/_2$—1 % of Bichrome.

Some acid dyed shades show quite satisfactory fastness properties: Fast Acid Blue R and Patent Blue A shaded with Acid Alizarine Grey G, Flavazine T and Fast Acid Violet; also pearl shades and bluish whites are best obtained with Fast Acid Blue R.

Fast reddish tints, strawberry and salmon shades are obtained with Alizarine Red 1WS shaded with Mordant Yellow O and Patent Blue A for yellowish hues; with Patent Blue A and Fast Acid Violet R for bluish hues. They are dyed in a Sulphuric acid bath and developed with Bichrome. In a similar manner Acid Alizarine Red G may be used as a ground colour for fancy red shades; this is then shaded with Mordant Yellow O or Alizarine Yellow GGW, Patent Blue A and Fast Acid Violet, as required.

Acid Alizarine Red G, Acid Alizarine Grey G and Acid Violet 5BF are also often used for the production of fast equalizing shades.

0,25 % **Fast Mordant Blue B**
0,02 % **Patent Blue A**
10 % Glauber's salt, 3 % acetic acid; 1 % sulphuric acid
0,5 % bichrome.

For more delicate and darker reddish tints Fast Acid Violet A2R is used, which is dyed in an acid bath and shaded with Patent Blue A, Orange G and Flavazine T.

Brown fancy shades are best obtained with Chromogen I which equalizes exceedingly well; it is dyed in a Sulphuric acid bath and developed with Bichrome, and can be shaded with Mordant Yellow O and Alizarine Yellow GGW towards yellow; with Fast Acid Violet A2R, Acid Alizarine Red G and Alizarine Red 1WS towards red, and with Patent Blue A or Milling Blue 2R extra towards blue.

0,4 % **Acid Alizarine Red G**
0,15 % **Acid Alizarine Violet N**
0,33 % **Fast Acid Violet R**
10 % Glauber's salt, 3 % sulphuric acid
0,75 % bichrome.

Shades equally fast to milling but still faster to light, are obtained with Acid Alizarine Brown B or BB as a foundation colour, which can be shaded with Mordant Yellow O, Alizarine Red 1WS or Acid Alizarine Red G. For shades inclining towards Grey, Acid Alizarine Brown is combined with Mordant Yellow O and Acid Alizarine Grey G, Acid Alizarine Blue Black B, 3B and Acid Alizarine Black R. In all cases it is advisable to dye in an Acetic acid bath; to add gradually some Sulphuric acid and then to chrome off with $^1/_2$—1 % of Bichrome according to depth of shade.

2,5% **Chromogen I**
0,15% **Mordant Yellow O**
0,025% **Patent Blue A**
10% Glauber's salt, 4% sulphuric acid
3% bichrome.

A combination of Fast Mordant Blue B, Acid Alizarine Red G and Mordant Yellow O yield also very fast brown fancy shades; they are especially fast to milling. Light grey shades are obtained most advantageously with Acid Alizarine Grey G or Acid Alizarine Blue Black B or 3B. For lighter tints the former is preferable on account of its equalizing properties, and it is dyed with Acetic acid. For deeper shades of grey, Acid Alizarine Blue Black B or 3B are more generally employed, which are also initially dyed in an Acetic acid bath to which is added some Sulphuric acid afterwards, before the shades are developed with chrome. These dyestuffs are shaded with Patent Blue A, Mordant Yellow O, Alizarine Yellow GGW, Acid Alizarine Red G, Alizarine Red 1WS and Fast Acid Violet A2R.

0,5% **Acid Alizarine Brown BB**
0,25% **Mordant Yellow O**
0,3% **Acid Alizarine Red G**
10% Glauber's salt, 3% acetic acid; 2% sulphuric acid
0,75% bichrome.

Heavier grey fancy shades are produced with Acid Alizarine Black R or Fast Mordant Blue B and R, together with Acid Alizarine Red G and Mordant Yellow O. For more delicate tints a combination of Patent Blue A, Alizarine Red 1WS and Alizarine Yellow GGW can be recommended.

The direct acid dyed shade of Acid Alizarine Grey is very fast to water and milling, so that it is often not necessary to develop the shade with Bichrome. In that case it is shaded with Fast Acid Blue R, Patent Blue A, Fast Acid Violet R, Fast Acid Magenta G, Orange G and Flavazine. When dyed in a direct acid bath, very delicate greys are obtained which are very even and satisfactorily fast.

The above mentioned combinations are distinguished for their fastness to milling; but they are also highly satisfactory as regards fastness to perspiration, light and alkali, and will answer all the requirements of the trade.

White and Pearl.

Pearl shades and Whites are produced as described on page 108. For white, those methods are to be considered which are especially applicable in mechanical dyeing machines, for instance, stoving with Bisulphite crystals to which eventually Methyl Violet or Fast Acid colours may be added for tinting, stoving in a vacuum, and especially bleaching with Hydrosulphite with the addition of some Indigo MLB/R. The production of pearl shades is carried out in a similar way, and we refer to the particulars given on page 108.

3. The dyeing of slubbing used for Knitting Yarns and Hosiery Goods.

A considerable quantity of slubbing is used for the production of knitting yarns and wool and half wool hosiery, and often for this purpose mixed with white. The colours which are suitable for these goods have to stand in the first place, good washing with soap and soda at 140° F (laundry washing); secondly they must be fast to perspiration and rubbing, so that they do not give rise to complaints in this respect, in wearing. The fastness to light of the colours used for hosiery goods need not be very considerable.

0,55% **Acid Alizarine Blue Black B**
0,35% **Acid Alizarine Brown BB**
0,03% **Mordant Yellow O**
10% Glauber's salt, 5% acetic acid; 2% sulphuric acid
0,75% bichrome.

It is necessary that knitting yarns and hosiery goods be dyed with colours which are fast to water, so that they may be steamed afterwards. This after-treatment consists in working the yarns in a neutral soap solution, hydroextracting them without rinsing, and then steaming them slightly in this half moist condition. The steaming serves to make the yarns open and soft. The colours must not change their shade, nor bleed into white in steaming. Sometimes, they have also to stand stoving if the goods contain white which is to be particularly pure. The shades used for knitting yarns and hosiery goods are comparatively limited: principally Black, Brown, Blue and Claret are asked for; less frequently, Magenta, Violet and bright Sky Blues.

Black.

Black is dyed most advantageously with Acid Alizarine Black, according to our particulars on page 92; the Acid Alizarine Black SN is especially suitable, on account of its fastness to washing. However, Acid Alizarine Black R, which also fast to washing, is much more often used, and likewise the Blacks T, RG, 3B and 3B extra. The bath is prepared with 10% of Glauber's salt, and 2% of Sulphuric acid and the necessary amount of dyestuff. The dyeing operation is commenced at 122° F then the liquid heated to the boil, 1—2% of Sulphuric acid added, and the goods boiled for 3/4—1 hour; after cooling the bath slowly, 2—3% of Bichrome are added and the shade developed by boiling for 3/4 hour. According to the

4% **Acid Alizarine Black T**
10% Glauber's salt, 3% sulphuric acid
2% bichrome.

4% **Acid Alizarine Black T**
10% Glauber's salt, 3% sulphuric acid
2% bichrome.

construction of the dye vessel, the Sulphuric acid may be added in several or in one portion. This applies especially to machines which permit of turning the tops easily. When using copper apparatus $1^{1}/_{2}$ ozs of Sulpho-Cyanide of Ammonia are added for every 100 gallons of liquid, in order to counteract the detrimental effect of the metal. For shading, Mordant Yellow O, Acid Alizarine Brown B, Acid Alizarine Red B, Acid Alizarine Grenade R and Fast Mordant Blue B and R are used, and in order to bring the shades up to pattern after chroming, some equalizing chrome resisting dyestuffs which are fast to washing, are to be recommended, such as Patent Blue A, Milling Blue 2R extra, Acid Violet 5BF, Fast Acid Violet R and Flavazine S.

Chromotrope S is another black dyestuff which, similarly to Acid Alizarine Black R, may be used for these purposes, yielding fast shades which are satisfactory in every respect. Chromotrope S (for jet blacks some Mordant Yellow O is used along with it) is dyed with 20% of Glauber's salt and 3% of Sulphuric acid, the bath is slowly heated to the boil, boiled for 1 hour, the steam turned off, 3% of Bichrome, 3% of Lactic acid and 1% of Sulphuric acid added through a dripping funnel, and the shade developed by boiling for $^{3}/_{4}$ hour.

Both Chromotrope S and Acid Alizarine Black R produce very even shades, which are fast to rubbing and withstand washing and steaming excellently; their fastness to perspiration is satisfactory and incomparably better than that of Logwood Black. They also excel the latter as regards fastness to stoving. Both dyestuffs approach in shade Logwood Black, and the sum total of their properties is considerably better.

Blue.

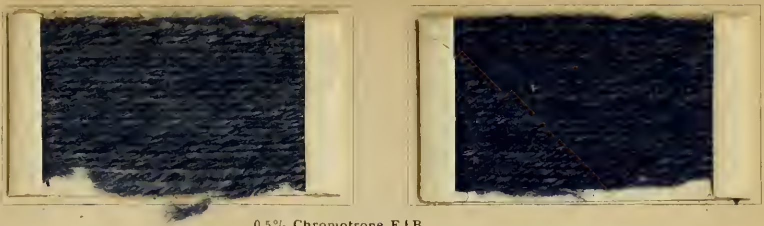
Dark Blue and Navy shades on knitting yarns are best obtained with blue chrome developing colours, such as Chromotrope DW, FB, F4B, Fast Mordant Blue R or B, which are shaded according to requirements with Patent Blue A, Acid Violet 5BF, Fast Acid Violet R, Mordant Yellow O and Alizarine Yellow GGW. When using these dyestuffs, it is advisable to avoid bright copper vessels, or at all events, to counteract the effect of copper by adding 1% of Sulpho-Cyanide of Ammonia to the dyebath.

Chromotrope FB and F4B are dyed in the same way as Chromotrope S Black. The bath is prepared with 20% of Glauber's salt and 3% of Sulphuric acid, the goods entered at 122° F the liquid heated to the boil and boiled for 1 hour; then 3% of Bichrome, 3% of Lactic Acid and 1% of Sulphuric acid are added, and boiling continued for $^{3}/_{4}$—1 hour. After chroming, the result may be shaded with Naphtalene Green V, Patent Blue A, Acid Violet 5BF, Fast Acid Violet R, Victoria Yellow conc., and Chrysoine G.

Fast Mordant Blue B and R are dyed in a bath prepared with 10% of Glauber's salt and 3—5% Acetic acid, to which are added 2—3% of Sulphuric acid. For developing the shades $1^{1}/_{2}$% of Bichrome are used (boiling for $^{1}/_{2}$—$^{3}/_{4}$ hour).

Contrary to Chromotrope, the Fast Mordant Blues require for their developing only one half the amount of Chrome and no Lactic acid; consequently their employment is especially suitable for the finer qualities of wool, because they remain softer and more open than when using Chromotrope. It is however advisable in most cases to dispense with the addition of Lactic acid, even when using Chromotrope FB and F4B, since the results obtained without Lactic acid are also very fast to washing. Blues produced with Chromotrope and Mordant Blue answer all requirements of the trade, as regards washing, steaming, rubbing, perspiration and stoving; they are cheap, and as the slubbings are treated only in one bath, they remain open and soft.

In this respect the blues obtained with Chromotrope and Fast Mordant Blue are distinctly superior to those obtained with Alizarine dyestuffs, although the latter yield results which are perhaps slightly faster to milling and light; still their cost is so much greater, that they are seldom used. This is also accounted for by the fact that Chromotrope and Fast Mordant



0,5% **Chromotrope F4B**
2% **Patent Blue RB**
0,15% **Acid Violet 5BF**
0,3% **Naphtalene Green V**
10% Glauber's salt, 2% sulphuric acid
1,5% bichrome, 1% sulphuric acid.

Blue do not change their shades in laundry washing as much as Alizarine Blue, and as the latter requires working in 2 baths (mordanting and dyeing), the slubbing being therefore boiled considerably longer, the quality is more easily impaired than is the case when using chrome developing colours.

2% **Indigo Substitute WE**
1,5% **Victoria Violet 4BS**
10% Glauber's salt, 4% sulphuric acid.

Still better is the process of dyeing in an acid bath without any aftertreatment, with Victoria Violet 4BS and Azo Acid Blue B, which can be shaded with Patent Blue A, Azo Acid Carmine B and Flavazine T, or with Indigo Substitute A extra, V extra, WE. Navy shades obtained in this manner are fairly fast to washing, and generally answer practical requirements, although of course they cannot be classed together with results obtained with Chromotrope FB and F4B, Fast Mordant Blue B and R; their fastness to water is also inferior, so that they must be steamed with great precaution in order to avoid stains and spots.

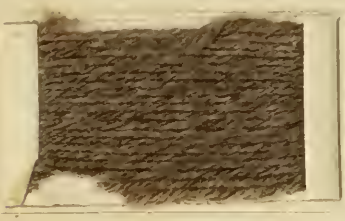
Brown.

Brown shades are most advantageously produced on slubbing for knitting yarns in a similar manner to the blue shades, with chrome developing colours. In the first place, this process is cheaper than Alizarine Brown, secondly the application is simpler and surer, and thirdly, the wool, being boiled for a considerably shorter period, retains its softness and pliability better.

For dark browns, Acid Alizarine Brown BB and T are used as the principal ingredients, which can be shaded according to requirements with Fast Mordant Blue R and B, Acid Alizarine Violet N, Acid Alizarine Red G and Mordant Yellow O, or with the following acid colours which are fast to washing: Patent Blue A, Acid Violet 5BF, Fast Acid Violet R and Flavazine T. The bath is prepared with 10% of Glauber's salt and 3% of Sulphuric acid or 5% of Acetic acid (in the latter case 1—2% of Sulphuric acid are added later, if required) and the shades developed with 1½—2½% of Bichrome.

Chrome Brown RO is also very suitable for the production of dark brown and red brown shades on slubbing, for knitting yarns and hosiery. It is dyed in an acid bath and developed like the Chromotropes, with or without the addition of Lactic acid. It is shaded with Alizarine Red 1WS, Acid Alizarine Grenade R, Acid Alizarine Red G and B towards red, with Mordant Yellow O towards yellow and with Chromotrope FB or F4B towards blue; after chroming, Patent Blue A, Fast Acid Violet R and Flavazine T may be added to dye up to shade.

Fast browns are obtained, moreover, by a combination of Alizarine Red 1WS, Acid Alizarine Red G or Acid Alizarine Grenade R and Mordant Yellow O. These colours are dyed in an acid bath and developed with bichrome. They may be shaded according to requirements with Fast Mordant Blue B, Acid Alizarine Grey and Acid Alizarine Brown.



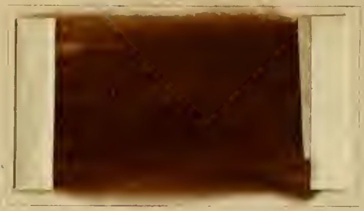
1,3 % Acid Alizarine Brown BB
0,6 % Mordant Yellow O
10 % Glauber's salt, 2 % sulphuric acid
2 % bichrome.

1.3 % Acid Alizarine Brown B
0,6 % Mordant Yellow O
10 % Glauber's salt, 2 % sulphuric acid
2 % bichrome.

Lighter browns, for instance, leather and drab shades are obtained by the same combination of the dyestuffs which equalize well and yield very even results. Furthermore, they may be produced with Acid Alizarine Brown BB, Acid Alizarine Red G and Mordant Yellow O which equalize equally well. Finally, Chromogen I is extremely suitable for the production of lighter browns and drabs. Chromogen I is dyed in an acid bath with 10 % of Glauber's salt and 4 % Sulphuric acid, and developed according to depth of shade with 2—5 % of Bichrome and the addition of 1—2 % of Sulphuric acid; it is shaded with Alizarine Red 1WS and Mordant Yellow O; after chroming, Patent Blue A, Fast Acid Violet R and Flavazine T or S are used for the same purpose. Shades obtained with Chromogen I are fast to rubbing and washing and satisfactorily fast to perspiration, so that they are most suitable for melange hosiery yarns which are used for the manufacture of the so called Jaeger material; also for tourist and hunting jerseys.

1,2 % Mordant Yellow O
0,8 % Alizarine Red 1WS powder
0,5 % Acid Alizarine Brown BB
0,1 % Acid Alizarine Grey G
10 % Glauber's salt, 3 % sulphuric acid
2 % bichrome.

Cheaper browns which do not require to be very fast to washing and bleeding, are obtained with Patent Blue A, Azo Acid Carmine B or Fast Acid Violet R and Flavazine T, or Chrysoine G. Shades obtained in this way will stand steaming, stoving and the ordinary



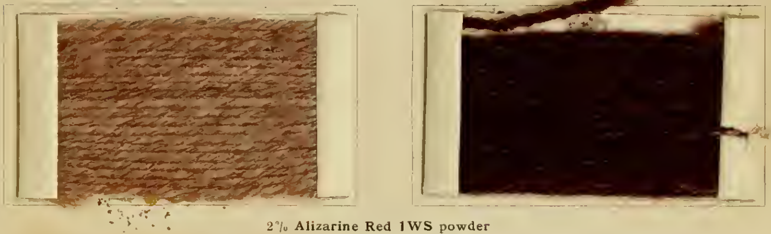
1% **Chromogen I**
0,35% **Acid Alizarine Brown BB**
0,25% **Mordant Yellow O**
0,05% **Acid Alizarine Grey G**
10% Glauber's salt, 5% acetic acid; 3% sulphuric acid
2% bichrome.

laundry washing fairly satisfactorily. However, after continuous use and repeated washing, the shades fade so much that this combination can only be employed for cheap goods.

The browns which are produced with Dianil Brown and Fast Dianil Brown are rather superior. These dyestuffs are employed with the addition of 10—20% of Glauber's salt and 5% Acetate of Ammonia or 2% of Acetic acid to the dyebath, and the latter is exhausted by gradually adding some more Acetic acid. Shades thus obtained are fast to washing and to water, and therefore quite satisfactory for knitting yarns.

Claret.

Claret shades which are used for one colour or melange yarns are produced with Acid Alizarine Grenade R and Acid Alizarine Red G and B as foundation colour. They are dyed in a Sulphuric acid bath, developed with 2 or 3% of Bichrome and shaded according to requirements with Acid Alizarine Violet N, Fast Acid Violet R, Milling Blue 2R extra, Patent Blue A and Mordant Yellow O. The shades obtained are fast to rubbing, washing and stoving; they are simply and quickly applied and yield very satisfactory results.



2% **Alizarine Red 1WS powder**
1,5% **Acid Alizarine Violet N**
0,6% **Acid Alizarine Brown BB**
0,6% **Mordant Yellow O**
10% Glauber's salt, 3% sulphuric acid
2,5% bichrome.

Another method for producing Claret shades, is to start with Alizarine Red 1WS which is combined with one or the other of the above mentioned red chrome developing colours; also with Fast Acid Violet R, Patent Blue A and Mordant Yellow O. The bath is prepared with 10% of Glauber's salt and 4% of Sulphuric acid, and the shade developed with 3% of Bichrome. These clarets are very fast to washing, but slightly inferior to the first mentioned combination as regards fastness to stoving and perspiration.

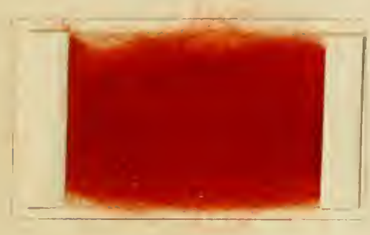
Cheaper than the former is the employment of Cloth Red O; this is dyed in a Glauber's salt bath which is slightly acidified with Sulphuric acid and aftertreated with Bichrome to increase the fastness to washing. These shades are equally as fast to rubbing as those obtained with Acid Alizarine Red and Acid Alizarine Grenade, and are faster to rubbing than those produced with Alizarine Red 1WS; however, the fastness to washing and water is inferior.

Claret shades obtained with Fast Acid Violet R, Fast Acid Blue B and Chrysoine G are slightly faster to washing than Cloth Red, but not better as far as bleeding is concerned.

They are dyed in an acid bath and aftertreated with Chrome Alum. When steaming these shades, great care must be exercised to avoid dripping stains and bleeding into white. In order to obtain shades which are very fast to washing and bleeding, Dianil Claret Red G and B and Dianil Violet H are used, which are shaded with Dianil Yellow, Dianil Brown and Dianil Red. They are dyed in an Acetic acid bath (raising the temperature very gradually to the boil) and this is exhausted with Acetic acid.

Bright shades.

Of all bright shades red plays the most important part. This is often mixed together with white for the production of pink yarns. Rosazeine O and B dyed in a neutral or weak acetic acid bath, is the dyestuff most employed. The colour is dissolved, then added to the bath and heated to 176° F only. In steaming Rosazeines great care is necessary to avoid bleeding. The yarns are therefore put into a soap solution after spinning, worked therein for a short time, then hydroextracted and immediately steamed. Great care must be taken not to let condensed water drip on to the goods, as this would produce unevenness and bleeding stains.



3 % **Dianil Red 4B**
30 % Glauber's salt
2,5 % acetic acid.

2 % **Milling Blue 2R extra**
0,75 % **Acid Violet 5BF**
10 % Glauber's salt, 4 % sulphuric acid; 10 % Chrome alum.

Blue bright reds can be dyed in a similar way with Magenta which is, if necessary, shaded up with Methyl Violet. The same precautions are needed in the further treatment of the yarns, as for Rosazeine.

Bright Scarlets are obtained with Milling Scarlet 4RO which is shaded with Milling Yellow O. It is dyed in an Acetic acid bath with Glauber's salt, the acid added in several portions through a dripping funnel, and the temperature gradually raised to the boil. Finally, 2 % of Fluoride of Chrome are added. These scarlets are very fast to washing, water, rubbing and perspiration; they are, however, slightly sensitive to strong sulphur stoving, which turns them yellower and it is advisable therefore to take this change into consideration when dyeing yarns which are to be stoved afterwards.

The following are very valuable for knitting yarns and most suitable for dyeing cheap reds fast to washing, on slubbing: Dianil Red, Brilliant Dianil Red and Delta Purpurine 5B. These colours are shaded according to requirements with Dianil Yellow, Dianil Brown, Dianil Claret Red, Dianil Violet etc. They are dyed in a weak Acetic acid bath (raising the temperature very slowly) which is exhausted by adding some more Acetic acid. Since the poor fastness to light of these colours is of no importance for the purpose of hosiery yarns, and, on the other hand, they are distinguished for fastness to washing and bleeding, they find ample application for knitting etc. materials.

Bright blue and violet shades are also now and then asked for, and they are obtained with Milling Blue 2R extra, Patent Blue A, Acid Violet 5BF and Fast Acid Violet R. They are dyed in an ordinary acid bath; an addition of Chrome Alum to the dyebath or an aftertreatment with Chrome Alum enhances the fastness to washing, so that no difficulty is experienced when steaming the yarns carefully afterwards.

4. The dyeing of slubbing by means of printing (Vigoureux printing).

Although the printing of all wool material will be discussed in a special volume on wool printing, it seems necessary here to mention the so-called Vigoureux printing (1) because it is carried out frequently in spinning mills (2) it is more closely related to the dyeing than to the printing of textures and yarns, and (3), it yields effects entirely different from those obtained in cloth and yarn printing. For the latter purposes, a permanent topic tinctorial effect is im printed upon the goods, whilst in the process which has taken its name from the inventor Vigoureux, only a partial dyeing of the separate wool fibres is aimed at, in order to obtain an even melange effect when these are mixed with white slubbing in spinning.

20	parts	**Rosazeine O**
580	,,	water
300	,,	British gum powder
30	,,	glycerine
50	,,	acetic acid 50°.
20	,,	oxalic acid (solid)
1000	parts.	

If melanges are produced by mixing dyed and white slubbing, very often unevennesses become apparent in the ready yarn or texture, which are caused by an incidental conglomeration of white and dyed fibres, and thus produce an uneven and often stripy appearance of the ready fabric.

The observation that slubbing, printed in stripes with colours, after spinning and weaving yields more even melange effects, has brought about the application of slubbing printing which is now used largely in the manufacture of men's suitings and ladies' cloths.

The principal feature of slubbing printing is to imprint diagonally upon the evenly and thinly spread sliver, some colour, by means of printing rollers. After printing the pastes which contain dyestuff, mordants, auxiliary mordants and thickening, the material is steamed in order to fix the dyestuffs, and then washed so as to remove the thickening and unfixed colour, unused mordant etc. The slubbing is then ready for spinning.

30	parts	**Scarlet 3 R**
570	,,	water
300	,,	British gum powder
30	,,	glycerine
50	,,	acetic acid 50°.
20	,,	oxalic acid (solid)
1000	parts.	

The depth of the shade of the ready fabric or texture depends not only upon the concentration of the printing pastes, but also upon the preparation of the engraved and the unengraved parts of the rollers. The smaller the engraved parts are, in comparison to the unengraved parts, the lighter will be the final effect; whilst vice versa the effects will be darker if the engraved parts are predominant.

The result depends greatly upon the purity and quality of the wool. On coarse material considerably deeper shades are obtained than on finer qualities. The slubbing must be well cleansed and free from fatty matters, oils etc., in order to take up the colours easily

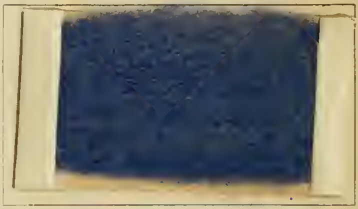
20	parts	**Patent Blue A**
580	,,	water
300	,,	British gum powder
30	,,	glycerine
50	,,	acetic acid 50 °/₀
20	,,	oxalic acid (solid)
1000	parts.	

and fix them well. For this purpose the material must undergo a thorough cleansing operation by passing it through weak alkaline soap in the back-wash; it is then well washed and dried.

Since the slubbing has to undergo the operation of spinning, after printing, great care must be exercised to preserve the fibre, and all unnecessary manipulations and the addition of ingredients to the printing colours which are liable to make the material harsh, must be avoided. For this reason the preparation of the slubbing with chlorine, which is generally resorted to in wool dyeing in order to intensify the effect and to save dyestuff, is omitted, because it would tend to deteriorate the pliability of the fibre and its milling capacity.

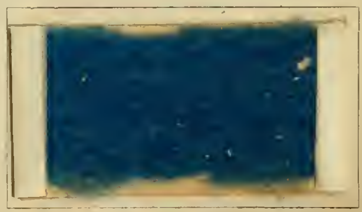
Generally only one colour is printed on white slubbing, but sometimes the printing operation is also carried out upon lightly dyed slubbing (pearl shades) which are obtained with Indigo or Fast Acid Colours such as Fast Acid Violet and Fast Acid Blue. It is to be noted that when printing upon dyed slubbing, the effects turn out much darker than on white goods, which is explained by the fact that the dyeing operation acts just as favourably for the taking up of colour, as the preparatory boiling of yarns or the crabbing and decatising of piece goods.

20	parts	**Alkali Blue 2B**
580	,,	water
300	,,	British gum powder
30	,,	glycerine
50	,,	acetic acid 50 °/₀
20	,,	oxalic acid (solid)
1000	parts.	



Two colours are very seldom printed simultaneously upon the slubbing, since it is an easy matter to produce multi-coloured effects by mixing one colour prints in the gill-box and then spinning the mixed material into inchange yarns. The printing pastes which contain dyestuffs, mordants, auxiliary mordants and thickenings must be kept rather thin in order to enable them to permeate the sliver thoroughly; but on the other hand, they must not be too thin else they would bleed. Thickening ingredients must be chosen which are easily removed by washing or soaping: British Gum, Dextrine, Burnt Starch, Senegal Gum and Tragacanth.

20	parts	**Acid Violet N**
580	,,	water
300	,,	British gum powder
30	,,	glycerine
50	,,	acetic acid 50 °/₀
20	,,	oxalic acid (solid)
1000	parts.	



50	parts	**Fast Mordant Blue B**
490	,,	water
300	,,	British gum powder
30	,,	glycerine
50	,,	acetic acid 50 °/₀
10	,,	sulphuric acid 169° Tw. (500 : 1000)
50	,,	fluoride of chrome
15	,,	water
5	,,	sodium chlorate
1000 parts.		

In preparing the printing pastes, it is essential to dissolve the colours thoroughly, and it is advisable to boil up the aqueous solutions before mixing them with the thickening.

The ingredients required for fixing the dyestuffs are added to the luke-warm or cold colour solutions and depend upon the kind of dyestuffs used. Acid colours also Developing and Mordant colours require the addition of acids: Acetic acid, Oxalic acid, Tartaric acid or their ammonium salts; these are split in steaming and liberate the corresponding colour acid. Sometimes Sulphuric acid or Sodium Bisulphate is also employed.

50	parts	**Vigoureux Black I**
10	,,	**Mordant Yellow O**
450	,,	water
300	,,	British gum powder
30	,,	glycerine
50	,,	acetic acid 50 °/₀
40	,,	sulphuric acid 169° Tw. (500 : 1000)
50	,,	fluoride of chrome
15	,,	water
5	,,	sodium chlorate
0,5	,,	sulpho-cyanide of ammonia
1000 parts.		

For fixing Mordant and Chrome Developing colours, Alum, alumina sulphate, fluoride of chrome, acetate of chrome, formiate of chrome, chromalene, and less frequently chromate salts are employed. The quantity of the mordant salts is to be kept as low as possible, since a surplus would interfere with the pliability of the slubbing.

Further additions to the printing pastes are: Phosphate of Soda which causes Dianil Colours to be taken up more readily; Sodium Chlorate which in steaming counteracts the reducing action of the wool and affects the dyeing strength of the colours advantageously; and Sulpho-Cyanide of Ammonia which is added to the printing paste in order to counterbalance the detrimental effect of copper rollers and metal furnishing boxes upon copper sensitive colours. Other additions, such as Glycerine, Turkey Red oil, Tournant oil serve for improving the permeation of the colours into the fibre and further the fixing of the colours; moreover they act favourably upon the handle of the material.

The steaming operation, which has the same effect as boiling in dyeing, viz: the fixation of the dyestuffs, is of paramount importance for the result. The fineness of the prints therefore depends greatly upon the exactness of the steaming process. For this purpose the printed

20	parts	**Vigoureux Brown I**
30	,,	**Mordant Yellow O**
460	,,	water
300	,,	British gum powder
30	,,	glycerine
50	,,	acetic acid 50 °/₀
40	,,	sulphuric acid 169° Tw. (500 : 1000)
50	,,	fluoride of chrome
15	,,	water
5	,,	sodium chlorate
0,5	,,	sulpho-cyanide of ammonia
1000 parts.		

slubbing is packed into baskets without being dried, and then steamed in a rectangular wooden or iron steam box with live steam. If the slubbing cannot be steamed at once, it is advisable to cover it up with moist cloths in order to prevent it from getting dry in places. The steaming operation is carried out for 1—1½ hours, without pressure. Mordant and Developing colours are sometimes steamed with a slight pressure of about ¼ atm. which improves the depth of the colours and their fastness.

Colours which are fixed with difficulty are steamed twice, and between each steaming operation the material is allowed to cool. The steamed slubbing is left to lie over-night, which darkens the shade; it is then washed in the back-wash with luke-warm water and soap solution, rinsed and dried.

On Indigo-Pearl-Ground:

50	parts	**Vigoureux Red I**
460	,,	water
300	,,	British gum powder
30	,,	glycerine
50	,,	acetic acid 50%
40	,,	sulphuric acid 169° Tw. (500 : 1000)
50	,,	fluoride of chrome
15	,,	water
5	,,	sodium chlorate
0,5	,,	sulpho-cyanide of ammonia

1000 parts.

As regards the selection of the colours, this depends upon the final purpose for which the slubbing has to serve. Slubbing used for gentlemen's suitings is printed with colours which are also used for the dyeing of similar goods: Alizarine Yellow GG, 5G, Mordant Yellow O, Alizarine Orange, Alizarine Red 1WS, Alizarine Grenade R, Alizarine Brown, the Alizarine Blue S brands, Alizarine Green S, Ceruleine S brands, Alizarine Direct Blue B, Alizarine Direct Green G, Fast Mordant Blue B, R, Acid Alizarine Blue, Acid Alizarine Green, Acid Alizarine Grey, Acid Alizarine Black, Acid Alizarine Brown, Acid Alizarine Grenade, Acid Alizarine Red, Acid Alizarine Yellow and Dianil Fast Red. To these must be added some colours which are suitable for printing only, such as Lanoglaucine W and the series of Vigoureux colours which are in a special degree adapted to printing. Patent

12,5	parts	**Vigoureux Black I**
12,5	,,	**Vigoureux Grey I**
495	,,	water
20	,,	ammonia
300	,,	British gum powder
30	,,	glycerine
50	,,	acetic acid 50%
40	,,	sulphuric acid 169° Tw. (500 : 1000)
25	,,	fluoride of chrome
10	,,	water
5	,,	sodium chlorate
0,5	,,	sulpho-cyanide of ammonia

1000 parts.

On Indigo-Pearl-Ground:

50	parts	**Mordant Yellow O**
425	,,	water
300	,,	British gum powder
62	,,	**Alizarine Blue DNW paste**
30	,,	glycerine
50	,,	formic acid 98%
30	,,	oxalic acid
50	,,	fluoride of chrome
15	,,	water

1000 parts.

Blue A, Milling Blue 2R extra, Acid Violet 5BF, Fast Acid Violet etc, which are also employed for the same purpose in dyeing may be used in small quantities, for shading purposes.

For printing slubbing which is to be manufactured into ladies' cloths, some acid colours may be used, in addition to the above mentioned mordant and chrome developing colours; besides, some Dianil colours which are distinguished for fastness to washing can be employed, such as Aurophenine, Dianil Yellow, Oxydianil Yellow, Dianil Red, Brilliant Dianil Red, Dianil Claret Red, Dianil Grenade and Dianil Brown.

The fastness required for ladies' cloths is very varied and the selection of the colours naturally corresponds to the quality and price of the material. It will be noted, therefore, that it is generally advisable to use the faster combinations, since the printer is seldom able to control the further treatment of the goods, and therefore, by choosing the fastest colours, he obviates complaints and defects. As the printing of the Fast Chrome Developing colours, Mordant and Vigoureux colours does not require any greater outlay for wages and steam than the printing of acid colours, and since therefore the difference in price between fast and loose colours in printing is much smaller than in dyeing, the application of the former is to be recommended as much as possible, and only in such cases where the peculiarity of the shade or other important circumstances require this course, ought Acid colours to be used.

5	parts	**Mordant Yellow O**
265	,,	water
150	,,	British gum powder
30	,,	glycerine
400	,,	**Ceruleine B paste**
50	,,	acetic acid 50%
40	,,	fluoride of chrome
10	,,	water
50	,,	oxalic acid
1000	parts.	

Some particulars may serve as a guide for preparing printing pastes: When using Acid and Dianil Colours for printing, the dyestuffs are dissolved in the given amount of hot water, then the thickening added and the whole boiled until thoroughly intermixed; then the paste is cooled, the various auxiliary ingredients added, and the whole made up to 1000 parts. In this manner all Acid colours with the exception of the Black Azo colours may be printed. By adding 10—20 parts of Alum to 1000 parts printing colour, a better fixation is obtained; the fact must not be lost sight of that Chromotrope 2R, 2B, 6B, 8B and 10B turn out considerably bluer and faster with the addition of Alum.

Fast Mordant Blue is dissolved in hot water, then British gum is added, and the whole boiled up. After cooling, Glycerine, Acetic acid, Sulphuric acid, and finally, Fluoride of Chrome and Sodium Chlorate made into a paste with water, are stirred into the printing mixture.

For the fixing of Fast Mordant Blue B and R it is advisable to steam rather more vigorously; that is, for 1½ hours with ½ atm. pressure with slowly circulating steam.

The Vigoureux colours are prepared in the same manner as Fast Mordant Blue.

The Acid Alizarine colours, especially Acid Alizarine Blacks, are also printed according to this recipe.

Mordant colour printing pastes are prepared by first making an aqueous solution or diluting paste colours thoroughly, and boiling these with the thickening; then, after cooling the paste, the other ingredients, especially the necessary metal salts required for developing the shade, are added.

Bisulphited pastes are prepared by boiling the thickening in water, adding small amounts of Acid colours required for shading, then cooling the mixture, and finally stirring into it the bisulphited dyestuff, and lastly, the other ingredients.

Mishaps liable to occur in the dyeing of Slubbing.

In the dyeing of slubbing mishaps occur more seldom than in the dyeing of loose wool, yarn, or piece goods. This is accounted for in the first place by the fact that the slubbing is generally fairly clean, and further because in a mechanical apparatus the goods are protected from many external influences which might act deleteriously during the dyeing process.

The most frequent mishaps which are met with in slubbing dyeing are the following:

At the point where the dye liquor enters, often a separation of the dyestuff may take place, which is liable to stop partially or completely the action of the pump; also the first washing bath may contain a large quantity of precipitated dyestuff:

In such a case the cause must be traced to the fact that on account of poor solubility, the dyestuff used is unsuitable for dyeing slubbing in a mechanical apparatus. More frequently however, the cause is to be attributed to neglect in dyeing, i. e. the necessary caution has not been observed, so that, not taking the nature of the dyestuff into consideration, the bath has been heated too quickly, or the acid used to exhaust the dyebath has been added too rapidly. Sometimes also the dyestuff has not been properly dissolved. It may here be called to mind that many dyestuffs, such as Alizarine Brown paste and Ceruleine paste must be dissolved and dyed with the addition of Ammonia. If this precaution has not been observed, or if the bath has been too quickly or too strongly acidified, the dyestuff is precipitated and is for the most part deposited on the slubbing at the place of contact with the dye liquor. This then brings about insufficient fastness to washing: the dyestuff is stripped in the washing baths of the back-wash.

The colours rub badly in succeeding operations: The material has not been well cleansed, but contains fatty impurities, spinning oil etc., so that a good fixation of the dyestuffs cannot take place. To prevent this evil the material must be treated before dyeing in a luke-warm bath with Ammonia, or if necessary, with Soda.

The dyed slubbing shows white spots and undyed places: In many cases this is not a very serious drawback however, since the undyed places disappear in gilling and spinning: but still it is advisable to prevent it as far as possible. The cause of this defect lies mostly in the unsatisfactory working of the pump, which may be either too weak for the purpose, or faultily constructed; or it may be due to insufficient circulation of the liquor as a result of the precipitation of dyestuff (as already mentioned above).

After dyeing and drying, the slubbing has a sticky handle, rubs badly, and does not work smoothly in spinning:

This defect is noticeable mostly when dyeing with Acid and Chrome Developing dyestuffs, and seldom appears when using Mordant dyestuffs. It is explained in the following manner: The first washing bath in the back-wash often contains soap solution; this is of no consequence when dyeing with Mordant colours, since these at the end of the dyeing operation contain practically no acid and therefore leave the soap bath undisturbed. However, when employing Acid- and Chrome Developing dyestuffs, which are worked in a fairly strong acid dyebath, the goods often retain some acid and when brought direct into a soap bath, the soap solution is split up, liberating free fatty acids which are fixed on the material, and thus producing a sticky handle, impairing the pliability and causing the colour to rub on to the metal parts of the spinning frame. It is therefore advisable in these cases, to prepare the first bath in the back-wash with water only. It is still better, however, to add some Ammonia so as to neutralise any acid left in the material. By so doing, the separation of free fatty acids in the soap bath may be absolutely prevented.

The slubbing is dyed unevenly, the outside being different from the inside:

If this defect has not been caused by any of the difficulties mentioned before (too rapid dyeing; adding the acid too quickly, or heating the dyebath too rapidly) and if the circulation of the liquor has not been faulty in any way, it is probably due to uneven exhaustion of the dyestuff used for shading. Therefore, if mordant dyestuffs or other dyestuffs which equalize with difficulty are added for shading, the acid dyebaths must always be neutralized or diluted before adding the shading dyestuff. The shading with Mordant dyestuffs and the addition of Chrome Developing colours after the treatment with Chrome, should never be attempted without observing the above precautionary measures, and only such dyestuffs of this group as equalize well, ought to be employed, viz: Acid Alizarine Brown, Acid Alizarine Grey, Acid Alizarine Violet N, Acid Alizarine Crimson R. It is advisable to shade off with well-known level dyeing dyestuffs, such as Patent Blue A, Milling Blue 2R extra, Acid Violet 5BF, Fast Acid Violet R and A2R which, in quantities up to about 0.5%, possess excellent fastness to milling, and are satisfactorily fast to light and alkali.

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